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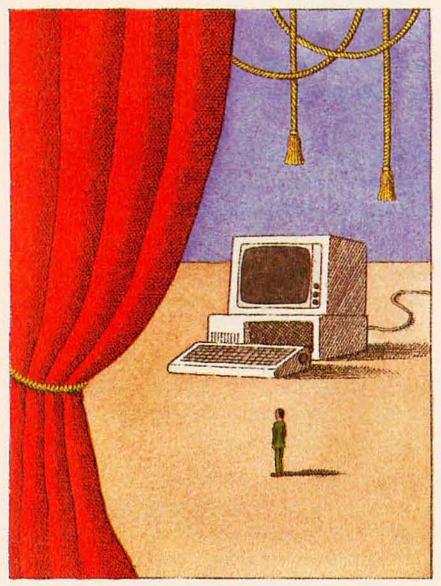
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THEME: HOMEBOUND COMPUTING

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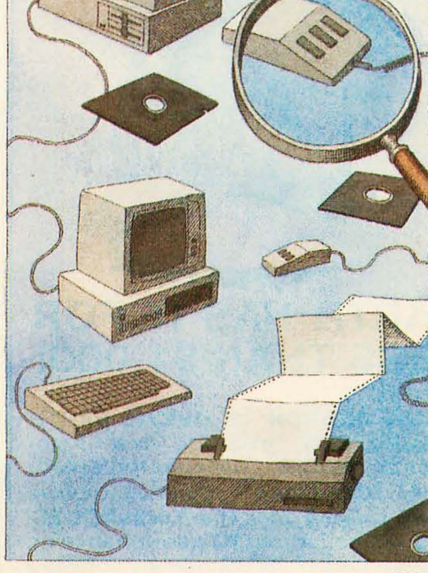
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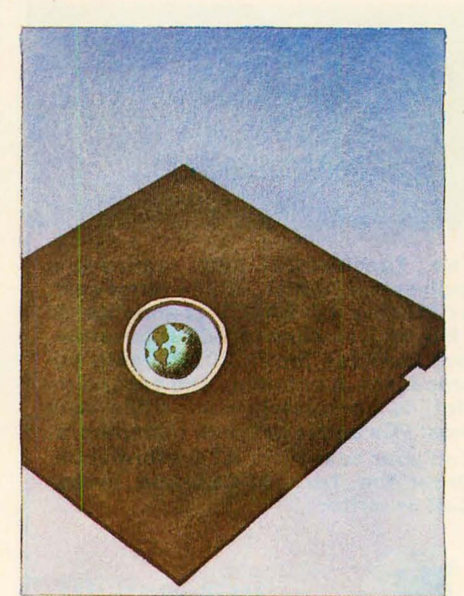
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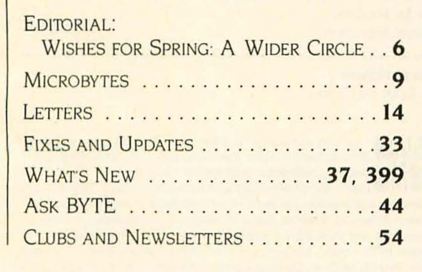


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E·D·I·T·O·R·I·A·L

WISHES FOR SPRING: A WIDER CIRCLE

When will personal computers reach far beyond the current circle of owners and produce another boom in our industry? Computer users and the industry alike have been awaiting the introduction of IBM's next base personal computer for more than a year. Everyone expects the machine to be a much better vehicle for software such as Microsoft Windows than is the current PC family. However, some reliable sources insist that IBM is now caught with an inventory of PCs, XTs, and ATs well in excess of one million machines. If this is true, IBM's new base machine must wait. Not even IBM can afford to write off billions of dollars in order to make way for a new product. It appears that the IBM side of the industry will stagnate, although IBM's RT will provide some stimulus before the replacement arrives for the base PC. And when the next IBM workhorse arrives, its pricing will probably assure that it replaces existing PCs and XTs rather than extending the benefits of the personal computer to new users.

It seems more likely that a breakthrough will come on the 68000 side of the market. The Atari 1040ST is one of the great milestones in personal computing. For the first time, we can buy a 16-bit machine with 1 megabyte of RAM, 720K bytes of floppy-disk storage, a good monitor, and a mouse, all for less than $1000. The operating system, TOS, is fully in ROM. Although screen memory and systems software make some demands on RAM, most of the megabyte really does belong to the programmer, and therefore to the user. Given its price and power, the Atari 1040ST is the first personal computer that offers programmers the hardware resources needed to make the computer accessible, responsive, and useful to millions of nontechnical people who have yet to use computers. But the software needed to take advantage of the hardware is yet to be seen. Only Tom Hudson's DEGAS paint program takes full advantage of chief designer Shiraz Shivji's hardware. (For more on the 1040ST, see the Product Preview by Phillip Robinson and Jon Edwards on page 84.) Jack Tramiel is capable of putting millions of these machines in homes around the world. The sheer numbers and raw computing power will drive software development, but it takes time.

Apple's January announcements revealed significant improvements in the Macintosh family. With the increase in standard RAM to a megabyte and the introduction of an SCSI interface, Apple showed that it does indeed plan to open the architecture of the Macintosh. A Macintosh with slots can be expected as soon as feasible, but the required changes in systems software to add more processing power and support the slots while retaining compatibility with today's Macintosh may take time. Furthermore, the $2495 price tag of the Macintosh Plus may prevent the Macintosh family from winning many new adherents. (We were unable to get access to a Macintosh Plus in time to prepare an article for this issue, but look for coverage in April or May.)

The Commodore Amiga is now the oldest of these three flagship 68000 machines. The Amiga's coprocessors still give it the edge in computation, but the Amiga trails both the Macintosh Plus and the Atari 1040ST in the standard configuration of RAM. Software runs on processors, but it lives in RAM. Commodore will soon have to offer an inexpensive upgrade to 1 megabyte of RAM in order to remain competitive and reduce programmers' headaches. The Amiga's open architecture should make the upgrade easy to do. We should also remember Commodore's statement when introducing the Amiga that it is the first and least powerful of a planned series of machines. Although Textcraft (with which this editorial is being written) is adequate and Electronic Arts' Deluxe Paint is spectacular, the Amiga still generally lacks software to match its hardware.

MAKING ONE MARKET

The Atari 1040ST and the Amiga fall short of the Macintosh in both systems software and applications software. Many, many personal computer users have said they'd like to see Macintosh-quality software on Atari or Amiga hardware. Any company or group of programmers that fulfills this wish could bring about the next great chapter of growth in personal computing. But who will do it?

Is there a remote possibility that Microsoft will put an MS-DOS-compatible operating system on the Amiga, the Atari ST, and the Macintosh, and put Microsoft Windows atop the operating system? Such a move would let Microsoft bestride the world of personal computers and unite the office, home, and education markets. Microsoft has produced a fine BASIC for the Amiga and must be tempted to simplify support for the machine by putting a Microsoft operating system in the Amiga's Writable Control Store (Kickstart RAM). But would Microsoft be bold enough to replace the ROMs and systems software of the Macintosh?

One of January's fascinating rumors suggested that Digital Research would introduce CP/M-68K and GEM for the Amiga, thereby fusing the Amiga and Atari into a single market. This would be a step in the right direction and would help Amiga and Atari by giving programmers a bigger market to write for. But Digital Research seems unlikely to try replacing the systems software of the Macintosh. The recent controversy over GEM's visual resemblance to the Macintosh user interface provides enough to occupy Digital Research's lawyers.

Lattice has taken a positive step by developing MacLibrary for the Amiga. These routines work with Lattice C on the Amiga and emulate ROM calls on the Mac. MacLibrary should help some in porting applications software from the Mac to the Amiga. Lattice C is available for the Atari ST and perhaps a version of MacLibrary will be as well. Other versions of C, including Manx C, are available for all three machines.

Let's hope someone will have the vision and the resources necessary to make one vast software market of three substantial and overlapping ones. The Atari ST, the Commodore Amiga, and the Apple Macintosh are each an important part of personal computing. Together they could form a standard second to none and attract millions of new users to personal computers.

—*Phil Lemmons*
Editor in Chief


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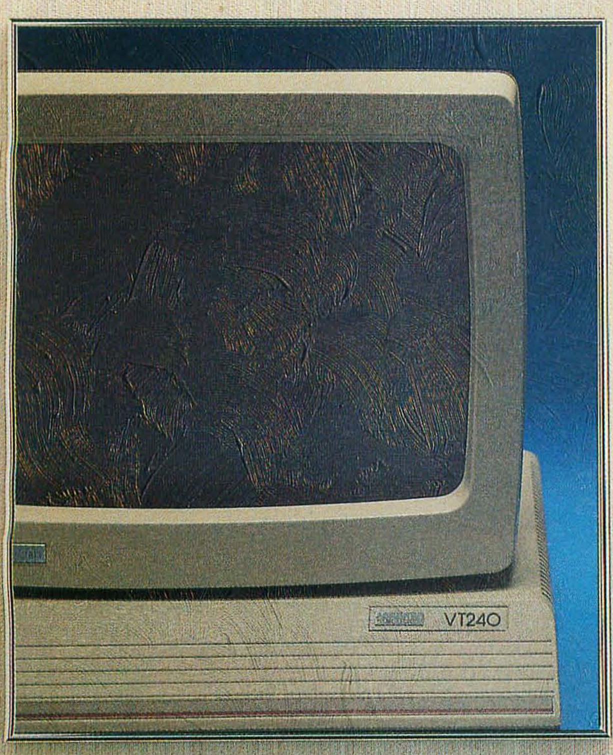
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STATE OF THE ART vs STATE OF THE SMART





Staff-written highlights of late developments in the microcomputer industry.

IBM Announces UNIX-based RISC-Technology Computer

IBM announced the RT PC, a line of desktop and floor-standing computers that feature a 32-bit RISC (reduced instruction set computer) microprocessor. The new machines also use a proprietary 40-bit-wide memory-management chip that can access a virtual memory of 1 trillion bytes. The desktop unit is the size of the IBM PC AT, has a 1.2-megabyte floppy drive, a 40-megabyte hard-disk drive, 1 to 3 megabytes of memory, and six IBM AT-compatible expansion slots. An optional 80286 board lets the RT run AT software.

AIX, the UNIX-based operating system for the RT, is compatible with UNIX System V and includes several enhancements from Berkeley version 4.2 UNIX. AIX can accommodate up to eight users.

Also announced were three high-resolution displays for the RT. These include the Advanced Monochrome and Color Displays, both with resolutions of 720 by 512 pixels, and the Extended Monochrome Display, with a resolution of 1024 by 768 pixels.

IBM claims that the RT can perform at a rate of 1.2 to 2.4 million instructions per second. The price for the desktop model with the Advanced Monochrome Display is approximately $13,100. The AIX operating system is an additional $3400. Discounts of over 30 percent are available for orders of 50 units or more.

Dutch Engineer Discloses Method for Eavesdropping on Computer Displays

In a recent issue of the journal *Computers & Security* (North-Holland), Dutch engineer Wim van Eck outlined a method whereby an ordinary television receiver can be modified to recreate the images on any nearby CRTs or computer displays. The modifications require approximately $15 of electronic parts and a directional antenna. In one test, van Eck set up his equipment in a van parked outside an office building and was able to read classified information displayed on a computer terminal inside the building.

Xerox Announces Color Ink-Jet Printer and Software for Its 6085 Computer

Xerox of Rochester, NY, announced a new printer for its line of personal computers and more software for its 6085 computer. The Xerox 4020 is a color ink-jet printer that reportedly prints 4000 combinations of seven primary colors at a resolution of 240 dots per inch. The printer price of $1495 includes the GEM Desktop, WordChart, and Graph software packages.

The Xerox 6085, a low-priced relative of the Xerox Star computer, is being bundled with Xerox's 4045 Laser CP (copier/printer) and new software to form a personal publishing system called the Documenter. No price was given for this system; projected availability is in the second quarter of 1986. Xerox will also offer compilers for C, FORTRAN, and BASIC that will run on the 6085 computer. The 6085 is a large-screen, window-and-mouse-oriented computer that is available with an optional IBM PC-compatible processor.

High-Density 256K-bit EEPROM

Xicor of Milpitas, CA, is selling samples of a 256K-bit EEPROM. The densest chip available before held 64K bits. The 256K-bit chip sits in the same package as the 64K-bit chip; for addressing, it employs two pins that were unused on the 64K-bit version. The 256K-bit EEPROM also includes new software data-protection mechanisms to guard against inadvertent writes during power-up and power-down. The 64K-bit chips cost from $12 to $20 apiece. The 256K-bit chip samples cost $120 in lots of 100. Full production is expected by the middle of 1986.

(continued)

Parallel Processing for the IBM

You can buy a parallel-processing add-on board for your IBM PC, XT, or AT or ITT XTRA from Compupix Technology of Boca Raton, FL. The board is based on NCR's GAPP (geometric arithmetic parallel processor) chip, which contains 72 CMOS 1-bit ALU processors. For $4750, you get a board with 144 processors (two GAPP chips), and $5750 buys you a board with 288 processors (four GAPP chips). Both products have an on-board sequence controller so the host computer can perform another task while the parallel processors are working.

The demonstration software that accompanies the boards was developed for both UNIX and MS-DOS environments. Compupix offers two assemblers for the board: the Macro-Meta Assembler runs under MS-DOS and costs $1750, while a relocatable, linkable version of the Macro-Meta Assembler costs $2150.

Datatext Word Processor Plus Source Code for $95

A $450 word processor that was withdrawn from the market for a few months has been reissued, this time with a complete source-code listing and a price of $95. Datatek of Oldsmar, FL, bills the new version of Datatext as a powerful, multifunction word processor and includes in the product's manual a complete listing of 30,000 lines of Pascal source code. A disk version of the source code costs $145, and a Computer Associates/Sorcim Pascal compiler for recompiling the code will be available for less than $100. The product runs on IBM PC, MS-DOS, and CP/M systems.

Nanobytes

According to **SoftView** of Camarillo, CA, its MacInTax 1985, a $75 program for the Macintosh, is the only tax package that can generate IRS-approved tax forms on the Apple Imagewriter printer. . . . **Epson** announced the FX-286 printer, a replacement for its FX-185 dot-matrix printer. Epson claims that the $749 wide-carriage printer is 30 percent faster than its older relative. . . . **Iomega Corp.** announced a new adapter card for its Bernoulli Box disk-cartridge system. The card lets the IBM PC boot from the Bernoulli Box. . . . **Fox & Geller** of Elmwood Park, NJ, is offering a Symphony-like database for Lotus Development's 1-2-3. Called Quickcode for 1-2-3, the program costs $199. . . . A new multiuser version of **Fox Research**'s 10-BASE database system for the IBM PC offers SQL (structured query language) features. . . . The **Toshiba** P351 dot-matrix printer can now emulate the Qume Sprint 11 daisy-wheel printer and the IBM Graphics Printer. Upgrades for older printers cost $99. . . . **Panasonic** announced three dot-matrix printers: the KX-P1595 (240 cps in draft mode, Courier type fonts, $949), the KX-P1592 (180 cps in draft, IBM Graphics Printer compatibility, $699), and the KX-P1080 (100 cps in draft, $319). . . . **Tiara Computer Systems** of Mountain View, CA, has acquired the Davong MultiLink local-area network and renamed it TiaraLink. The products will sell for 15 to 25 percent less. Tiara is also offering an IBM PC AT-compatible motherboard to developers for a single-quantity price of $920. . . . The **International Computer Users Groups Association** (ICUGA) has been formed in Lexington, KY. The association is intended as a support service for users groups around the world. Contact ICUGA c/o Abshire & Abshire, Security Trust Building, Suite 100, Lexington, KY 40507. . . . **Oki Semiconductor**, Sunnyvale, CA, has developed a 5-MHz CMOS version of the 8085A microprocessor. An NMOS 8085A draws 170 milliamperes; the MSM80C85A-2 typically draws less than 20 mA. In lots of 100, each chip costs $7.30. . . . **Aldus Corp.** of Seattle, WA, has introduced PageMaker release 1.1. This new version of the $495 Macintosh page-design program offers the option of using the LaserWriter's bit-map smoothing, a greater variety of tab uses, and support of tabloid-size pages (11 by 17 inches). . . . **S-MOS Systems** of San Jose, CA, announced three CMOS Z80 microprocessors. The SMC 84C00AC is simply a pin-compatible CMOS Z80. The SMC 84C00AC-L adds a low-power "sleep" mode that prohibits it from supporting the Z80's on-chip dynamic-memory-refresh counter. The SMC 84C00AC-S has both the sleep mode and an on-chip oscillator. All three chips sell for approximately $3 in quantities of 1000. . . . **Vitelic**, Santa Clara, CA, is making the V62C64, a low-power 8K-bit-by-8 CMOS static RAM chip. This new RAM has an access time of 150 nanoseconds and dissipates 175 milliwatts in operation or 10 microwatts in standby. A special low-voltage data-retention mode for battery backup lets the V62C64 retain data while dissipating only 4 microwatts from a 2-volt power source.

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Your first color good enough

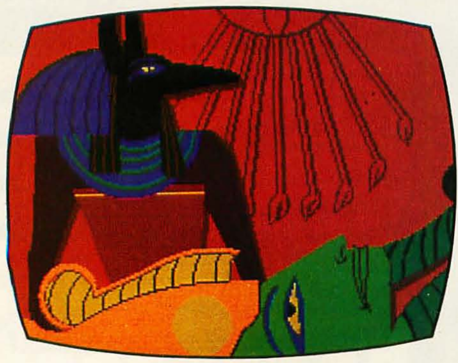
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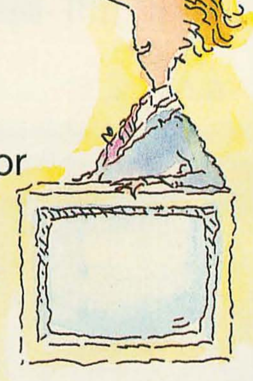
It gives you the best color resolution available at the price.

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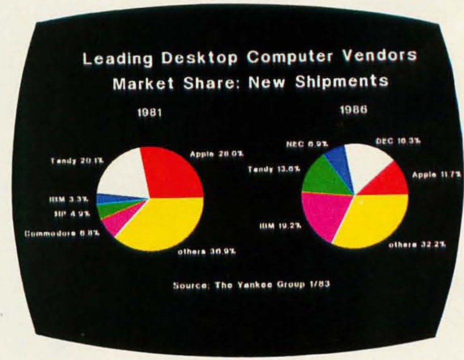


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COPYRIGHTING ICONS

Your January editorial ("A Threat to Future Software," page 6) regarding Apple's stifling of software creativity was precisely to the point. Legally, I have wondered why Xerox didn't sue Apple long ago. Technically, however, I also wondered why DRI chose to slavishly copy the Mac user interface in the first place.

Take scroll bars, for example. They take up an awful lot of screen space, are difficult to use accurately, and are hardly intuitive, since you need to go *right* first to go *up*! Why not just let a function key cause the cursor to adhere to the first window border it comes to? Option would cause the contents to scroll, Command might cause the window to resize, and Shift would move the window on the screen. Need to close the window? Just move the cursor rapidly back and forth a few times anywhere in the window (a motion similar to using a pencil eraser), and it would be gone. Presto, you have a window that operates far more intuitively than a Mac window, has less screen overhead, less code overhead (no need to draw the bars and resize them), and, best of all, has little resemblance to a Macintosh! And while they are at it, the DRI people might want to throw in support for a global zoom procedure (since every computer screen is only a window on an application) and the global abort function that the Macintosh sorely needs but doesn't have.

ALEX FUNK
Durham, NC

It is truly remarkable that Apple managed to copyright the garbage can (its primary symbol?) and the icon interface developed by Xerox.

It must be in the general interest to have a standard set of icons that express their meaning clearly and unambiguously.

Clearly, Apple is taking the necessary steps to prevent a natural development of such a standard. Is Apple trying to prevent other vendors from launching systems based on the ideas from Xerox? Do the people at Apple really think they will succeed? That is difficult to believe, as the bit map of an icon hardly is the major feature of a computer system, and more powerful machines will appear in the near future, easily outperforming the Mac in all aspects (except the garbage can).

GÖRAN RYDQVIST
KJELL POST
Linköping, Sweden

When I first learned that Apple had won a decision against Digital Research for "visual copyright" infringement, I thought "Right on!" and still feel this way. A programmer should be able to protect his rights to any commercial system he develops. We would all agree that the visual aspects and appearance of any software system contribute heavily to the success of that particular system in the marketplace. Your line of reasoning to justify other persons' ignoring visual copyrights—the "incremental" theory—if carried to its logical conclusion in my mind leads us to the point where my firm could publish a new software release called Wordstar 5000, emulating the latest MicroPro screens for its fine word-processing program. As long as we could prove incremental improvements, we would be protected from (not liable to) suit by MicroPro. This is ridiculous! It is the programmer's right to release newer, incrementally improved versions of any software product he has authored. If another firm feels it has a dynamite idea for an enhancement to an existing piece of software, then isn't that what joint ventures are for?

The computer industry is far away from the ideal man-computer-man interface. Let us collectively stimulate, encourage, and suitably reward those who pursue new, untried interface techniques. As the level of computer literacy rises above thinking of the computer as a car-type tool and reaches the level where we see the computer as an extension of our brains, we will all probably want our own individualized interfaces.

MIKE CARMICHAEL
Glasgow, KY

COVERING ATARI'S ST MACHINES

Well, another month has come and gone, and the only mention made of the best low-priced computer on the market is a few slightly snide remarks. I can't say that I am totally surprised, since it took BYTE a few years to figure out what every Atari owner knew—that the Atari 400/800/1200s were the best 8-bit graphics machines on the market.

Now comes a new Atari, the 520ST. It is available everywhere, right now, with software delivering now. Also available is a complete developer's software/documentation package for less than a good C compiler for the IBM PC and its look-alikes. Still, no real mention in BYTE. Methinks your biases are showing.

I will readily concede that the Amiga is probably a better machine, but at a price that is more than double that of a similarly equipped 520ST. Mr. Webster and others have said the 520ST is not expandable. Officially, that's true. But, as many owners of the Atari 400 know, the 400 wasn't expandable beyond 16K RAM, officially. I and many others have or had 400s with 48K within a year of introduction. My 520ST (remember, unexpandable) will shortly have 1 megabyte of RAM (cost: less than $70) and an add-on 80-track 5¼-inch drive. So much for officialdom.

When I bought my machine, I received BASIC, Logo, Neochrome (graphics drawing program), and ST Writer (word processor). While the graphics and word-processing software are not up to some of the more mature applications, they are far from primitive.

In my area, the Amiga is not available yet, but it will be in "real soon now." The dealer says there is lots of software for the Amiga, but he doesn't have any in stock; again, it will be here "real soon now." I don't know about you, but in the computer world "real soon now" can often take months or years.

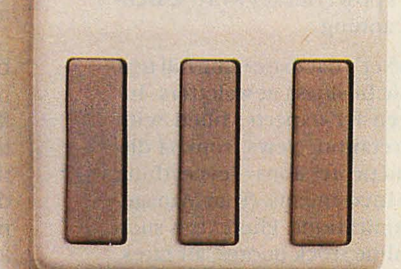
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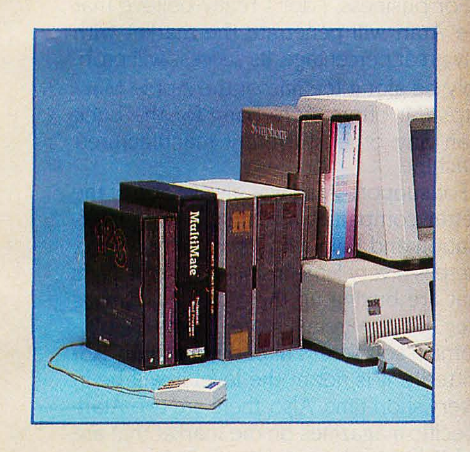
LETTERS POLICY: *To be considered for publication, a letter must be typed double-spaced on one side of the paper and must include your name and address. Comments and ideas should be expressed as clearly and concisely as possible. Listings and tables may be printed along with a letter if they are short and legible.*

Because BYTE *receives hundreds of letters each month, not all of them can be published. Letters will not be returned to authors. Generally, it takes four months from the time* BYTE *receives a letter until it is published.*

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Cursor Overshoot Control	Yes	No	No
Adjustable Cursor Speed/Up, Dn (while running application)	Yes	No	No
Adjustable Cursor Speed/Rt, Lft (while running application)	Yes	No	No
Buttons-Definable (while running application)	Yes	No	No
Macros-Definable (while running application)	Yes	No	No
User-Definable Alternate Cursor Movement	Yes	No	No

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As for comparing machines, we really have to compare machines that are similarly priced. With the Atari 520ST's $1000 price tag, that leaves the Apple II. Poor Apple. When comparing compatibility, then we have to look at the IBM PC/XT/AT and the Amiga. The PC/XT/AT's saving graces are manufacture by IBM and a large base of available software. I recently saw a benchmark on the 520ST for processing (primes). Nothing that anyone will buy for home use was anywhere close to Atari's speed.

For business, I don't really believe that the Atari will penetrate the market with any great percentage. Its success will probably be along the line of the Apple Macintosh. It offers more bang for the buck than any other currently manufactured machine.

For support, Atari was always one of the better companies about supplying information and help with its machines. Also, there is a very large installed base of users that are buying up the 520STs as fast as they hit the retail store. Some public-domain software is already out there. Admittedly, it is not at the level it will be in a very short time. Also, there are two Atari-specific magazines on the market that are publishing more and more information about the machine every month.

BYTE, your prejudices are showing, and by this letter you can see that mine are showing also. Maybe it will balance out.

LLOYD PARSONS
Herrin, IL

Phil Lemmons replies:
We are not prejudiced against Atari or any other company. We were hampered in covering Atari's 520ST by the company's refusal to give us access to a machine despite repeated attempts on our part. But that problem is now past. Please note that our January, February, and March issues all contain coverage of Atari's ST machines.

I'D KNOW THAT CHIP ANYWHERE

I don't know whether this is a coincidence or not, but a chip virtually identical to the one John Bennett has described ("Raster Operations," November 1985, page 187) was developed by myself and John Atwood at Silicon Compilers in early 1983. The chip, designed with the help of an early version of the Silicon Compilers software, has been used quite successfully in the Sun Microsystems Color Workstation. In this application, a total of eight RasterOp chips (one per bit plane) manip-

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ulate up to 128 bits of image data in parallel for high-speed screen updating. The Sun RasterOp chip is now available commercially from VLSI Technology Inc. as part VL16160.

ANDREAS BECHTOLSHEIM
Sun Microsystems Inc.
Mountain View, CA

KUDOS FOR CONFERENCING THEME

Congratulations on the fine December 1985 issue. We at Network Technologies International Inc. were pleased to see the thoroughness of the Computer Conferencing theme section. As you know, this is an exciting segment for the computer industry, and it has tremendous growth potential in the near future. The reputation of BYTE for being on the leading edge of technology news is well deserved, as this issue focused on conferencing proves.

We were very excited by the review of our eForum product by Brock Meeks ("An Overview of Conferencing Systems," page 169). However, several points deserve clarification:

1. eForum does have an electronic mail facility. It is an add-on software package called eMemo that allows private one-to-one communications with many of the enhanced organizational features of eForum.
2. The eForum software has a migration path that cannot be matched. NETI began marketing with eForum software available on supermicro and mini systems. Beginning in February, the eForum system will be available on an MS-DOS IBM PC-compatible microcomputer. And currently, eForum on a mainframe system is available through the largest packet-switching network in the world, the General Electric Information Service. We feel this wide range of options more than adequately serves the needs of Fortune 500 companies as well as organizations of every size and need.

JEFFREY J. ELPERN
Ann Arbor, MI

MS-DOS DISK FORMATS

Marcus Kolod, in his article "IBM PC Disk Performance and the Interleave Factor" (*Inside the IBM PCs*, Fall 1985, page 283), goes into considerable detail to describe how PC-DOS 1.*x* differs from 2.*x* in accessing a double-sided disk. He describes DOS 1.*x* as accessing all of side 0 and *then* all of side 1, while DOS 2.*x* will access both sides of each cylinder on the disk before

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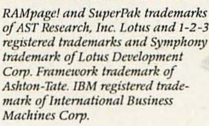
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- *Enhanced EMS design for greater performance with enhanced EMS software.*
- *AST Expanded Memory Manager software standard.*
- *New SuperPak™ utility software standard.*





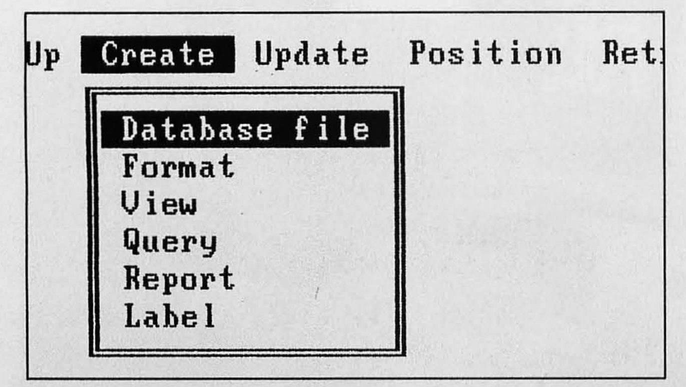
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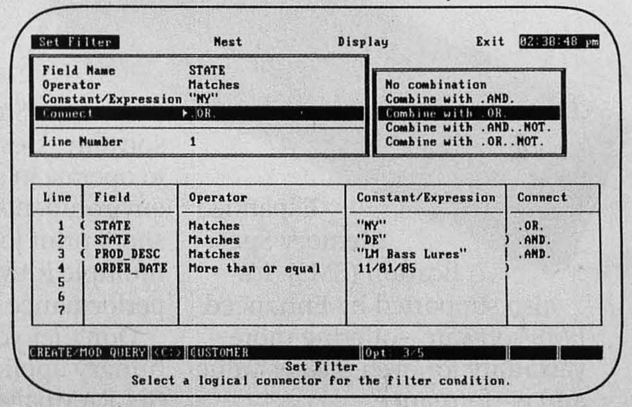
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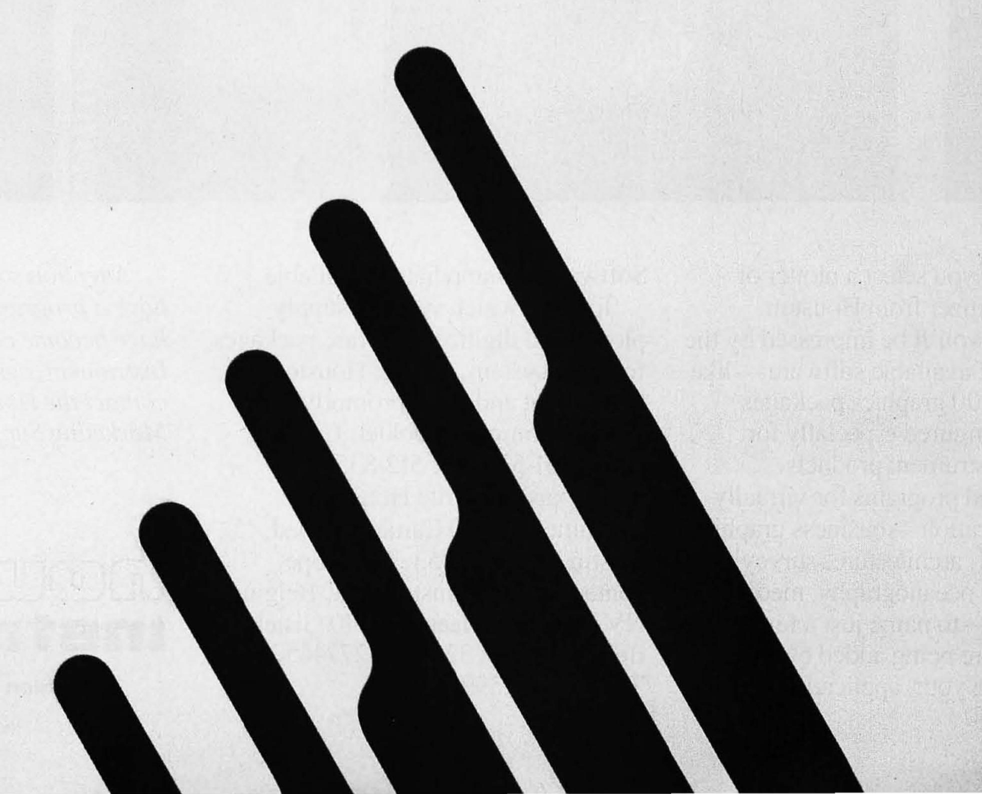
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Attention software vendors: If you have a program you would like to have become compatible with Houston Instrument's graphics products, contact the Houston Instrument Marketing Support Group.

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Inquiry 161

advancing to the next cylinder. (I have dubbed the first method "surface mode" and the second method "cylinder mode.")

DOS 1.*x* does not access the disk this way; it uses the same cylinder mode as does DOS 2.*x*. In fact, I have written device drives for 17 different MS-DOS disk formats, ranging from 3½ inches to 8 inches to the AT high-density, and I've yet to see an MS-DOS surface-mode disk.

I have seen many other differences in MS-DOS floppy-disk formats, however. Several manufacturers have made changes to improve performance or to match their system design. I've seen sector sizes from 256 bytes (HP 150) to 1024 bytes (NEC APC 8-inch), cluster sizes from 512 to 4096 bytes, one boot sector (the most common) to two entire tracks (DEC Rainbow), base sector addresses of both 0 and 1, logical to physical sector mapping via a translation table (à la CP/M), and the 3½-inch 600-rpm high-speed Hewlett-Packard drive (usual speed is 300 rpm). Plus, of course, the IBM PC AT-style drive. Unfortunately, the "media descriptor byte" is not unique for each of these different formats.

I expect I will continue to see more differences in future MS-DOS disk formats; it keeps my life interesting.

GARY SANFORD
Acton, MA

ADDING RAM TO THE AMIGA

Thanks for printing my letter on the Amiga's RAM layout (Letters, November 1985, page 26). Thanks also to Gregg Williams for his reply, which requires further comment.

Extensive changes apparently would have been necessary to provide for future upgrades to more than 512K bytes of RAM on the Amiga motherboard, even if the upgrades were to be accomplished simply by swapping chips. As I understand it, there is a segmentation between the core 512K-byte RAM on the one hand and the larger address space available to the external bus expansion port on the other hand. The Amiga's custom processing chips apparently work only within the 512K-byte space; to expand this core RAM, the very architecture of the system apparently would have to have been rearranged. This is "rather extreme," indeed.

But after deflating my letter of its "rather extreme" atmospheres, I'm still left with the central point that caused me to write: Why is an optional cartridge necessary just to get 512K in the first place?

Including a full 512K bytes on the Amiga motherboard, using 16 standard 256K by

(continued)

1-bit RAM chips, probably would have added something less than $30 to the manufacturing cost. This would have been partly offset by the cost-reducing elimination of the optional cartridge slot, since more than 512K bytes of core RAM apparently would not have been practical, anyway.

The earlier 128K-byte prototype motherboard had 16 standard 64K by 1-bit RAM chips, so this hypothetical upgrade to 512K bytes using 16 standard 256K by 1-bit RAM chips should have been an obvious one. The Amiga's designers must have gone out of their way to use eight nonstandard 64K by 4-bit RAM chips in order to hold standard memory down to 256K bytes and require the optional cartridge for the second 256K bytes. That was my main point, and the design choice remains inexplicable to me.

I didn't want to leave the impression that I don't like the Amiga. In fact, it is precisely because I *do* like it that the memory scheme arouses my criticism; it seems to stick out like a sore thumb amidst all those wild custom processing chips. The Amiga's capabilities eat up lots of memory, and the 512K-byte core RAM should have been provided in a far more cost-effective manner. The basic Amiga should have 512K bytes of RAM, yet still be priced at $1295 or less.

JIM HOWARD
Project City, CA

USING THE M68000 FOR SCIENTIFIC RESEARCH

L. David Roper (Letters, October 1985, page 24) has apparently been misinformed about the M68000 family. The 68020 has 32-bit address and data buses with a 32-bit ALU and two 32-bit adders internally. It also has 32- by 32-bit multiply and 64- by 32-bit divide. The 68881 floating-point coprocessor is available in sample quantities right now and should be available for general use soon.

The 68020 is already in use. As of this date, GIMIX Inc. (in Chicago) is producing one computer with the 68020 and will soon be making a single-board computer with that chip.

I hope Mr. Roper will reconsider his decision to exclude the M68000 family from consideration in choosing a scientific computer.

CALVIN DODGE
Wheatridge, CO

REMOTE DIAGNOSTICS SCHEMES

Remote diagnostics offer the industry great promise, as your editorial "Service and Support" (February 1985, page 6) indicated, but their implementation is filled with "very serious problems," as a letter from Paul Pinette in the October 1985 issue (page 14) showed. The solution is not remote, however, because a carefully designed system architecture can allow us to have our bugs and eat them, too.

The old dilemma haunting the successful use of remote diagnostics occurs when the diagnostic requires the CPU, main memory, and data paths all to be operational to test a failing system. The failed system won't respond. The system can't diagnose itself for the same reason it won't respond: It's broken! There is a workable solution to this dilemma, and it is being used now. The independent multiboard architecture of the Altos 2086 and

(continued)



The C for Microcomputers

PC-DOS, MS-DOS, CP/M-86, Macintosh, Amiga, Apple II, CP/M-80, Radio Shack, Commodore, XENIX, ROM, and Cross Development systems

MS-DOS, PC-DOS, CP/M-86, XENIX, 8086/80x86 ROM

Manx Aztec C86

"A compiler that has many strengths . . . quite valuable for serious work"

Computer Language review, February 1985

Great Code: Manx Aztec C86 generates fast executing compact code. The benchmark results below are from a study conducted by Manx. The Dhrystone benchmark (CACM 10/84 27:10 p1018) measures performance for a systems software instruction mix. The results are without register variables. With register variables, Manx, Microsoft, and Mark Williams run proportionately faster, Lattice and Computer Innovations show no improvement.

	Execution Time	Code Size	Compile/ Link Time
Dhrystone Benchmark			
Manx Aztec C86 3.3	34 secs	5,760	93 secs
Microsoft C 3.0	34 secs	7,146	119 secs
Optimized C86 2.20J	53 secs	11,009	172 secs
Mark Williams 2.0	56 secs	12,980	113 secs
Lattice 2.14	89 secs	20,404	117 secs

Great Features: Manx Aztec C86 is bundled with a powerful array of well documented productivity tools, library routines and features.

Optimized C compiler	Symbolic Debugger
AS86 Macro Assembler	LN86 Overlay Linker
80186/80286 Support	Librarian
8087/80287 Sensing Lib	Profiler
Extensive UNIX Library	DOS, Screen, & Graphics Lib
Large Memory Model	Intel Object Option
Z (vi) Source Editor -c	CP/M-86 Library -c
ROM Support Package -c	INTEL HEX Utility -c
Library Source Code -c	Mixed memory models -c
MAKE, DIFF, and GREP -c	Source Debugger -c
One year of updates -c	CP/M-86 Library -c

Manx offers two commercial development systems, Aztec C86-c and Aztec C86-d. Items marked -c are special features of the Aztec C86-c system.

Aztec C86-c Commercial System $499
Aztec C86-d Developer's System $299
Aztec C86-p Personal System $199
Aztec C86-a Apprentice System $49

All systems are upgradable by paying the difference in price plus $10.

Third Party Software: There are a number of high quality support packages for Manx Aztec C86 for screen management, graphics, database management, and software development.

C-tree $395	**Greenleaf $185**
PHACT $250	**PC-lint $98**
HALO $250	**Amber Windows $59**
PRE-C $395	**Windows for C $195**
WindScreen $149	**FirsTime $295**
SunScreen $99	**C Util Lib $185**
PANEL $295	**Plink-86 $395**

MACINTOSH, AMIGA, XENIX, CP/M-68K, 68k ROM

Manx Aztec C68k

"Library handling is very flexible . . . documentation is excellent . . . the shell a pleasure to work in . . . blows away the competition for pure compile speed . . . an excellent effort."

Computer Language review, April 1985

Aztec C68k is the most widely used commercial C compiler for the Macintosh. Its quality, performance, and completeness place Manx Aztec C68k in a position beyond comparison. It is available in several upgradable versions.

Optimized C	Creates Clickable Applications
Macro Assembler	Mouse Enhanced SHELL
Overlay Linker	Easy Access to Mac Toolbox
Resource Compiler	UNIX Library Functions
Debuggers	Terminal Emulator (Source)
Librarian	Clear Detailed Documentation
Source Editor	C-Stuff Library
MacRam Disk -c	UniTools (vi,make,diff,grep) -c
Library Source -c	One Year of Updates -c

Items marked -c are available only in the Manx Aztec C86-c system. Other features are in both the Aztec C86-d and Aztec C86-c systems.

Aztec C68k-c Commercial System $499
Aztec C68d-d Developer's System $299
Aztec C68k-p Personal System $199
C-tree database (source) $399
AMIGA, CP/M-68k, 68k UNIX call

Apple II, Commodore, 65xx, 65C02 ROM

Manx Aztec C65

"The AZTEC C system is one of the finest software packages I have seen"

NIBBLE review, July 1984

A vast amount of business, consumer, and educational software is implemented in Manx Aztec C65. The quality and comprehensiveness of this system is competitive with 16 bit C systems. The system includes a full optimized C compiler, 6502 assembler, linkage editor, UNIX library, screen and graphics libraries, shell, and much more. The Apple II version runs under DOS 3.3, and ProDOS, Cross versions are available.

The Aztec C65-c/128 Commodore system runs under the C128 CP/M environment and generates programs for the C64, C128, and CP/M environments. Call for prices and availability of Apprentice, Personal and Developer versions for the Commodore 64 and 128 machines.

Aztec C65-c ProDOS & DOS 3.3 $399
Aztec C65-d Apple DOS 3.3 $199
Aztec C65-p Apple Personal system $99
Aztec C65-a for learning C $49
Aztec C65-c/128 C64, C128, CP/M $399

Distribution of Manx Aztec C

In the USA, Manx Software Systems is the sole and exclusive distributor of Aztec C. Any telephone or mail order sales other than through Manx are unauthorized.

Manx Cross Development Systems

Cross developed programs are edited, compiled, assembled, and linked on one machine (the HOST) and transferred to another machine (the TARGET) for execution. This method is useful where the target machine is slower or more limited than the HOST, Manx cross compilers are used heavily to develop software for business, consumer, scientific, industrial, research, and educational applications.

HOSTS: VAX UNIX ($3000), PDP-11 UNIX ($2000), MS-DOS ($750), CP/M ($750), MACINTOSH ($750), CP/M-68k ($750), XENIX ($750).

TARGETS: MS-DOS, CP/M-86, Macintosh, CP/M-68k, CP/M-80, TRS-80 3 & 4, Apple II, Commodore C64, 8086/80x86 ROM, 68xxx ROM, 8080/8085/Z80 ROM, 65xx ROM.

The first TARGET is included in the price of the HOST system. Additional TARGETS are $300 to $500 (non VAX) or $1000 (VAX).

Call Manx for information on cross development to the 68000, 65816, Amiga, C128, CP/M-68K, VRTX, and others.

CP/M, Radio Shack, 8080/8085/Z80 ROM

Manx Aztec CII

"I've had a lot of experience with different C compilers, but the Aztec C80 Compiler and Professional Development System is the best I've seen."

80-Micro, December, 1984, John B. Harrell III

Aztec C II-c (CP/M & ROM) $349
Aztec C II-d (CP/M) $199
C-tree database (source) $399
Aztec C80-c (TRS-80 3 & 4) $299
Aztec C80-d (TRS-80 3 & 4) $199

How To Become an Aztec C User

To become an Aztec C user call 1-800-221-0440 or call 1-800-832-9273 (800-TEC WARE). In NJ or outside the USA call 201-530-7997. Orders can also be telexed to 4995812.

Payment can be by check, COD, American Express, VISA, Master Card, or Net 30 to qualified customers.

Orders can also be mailed to Manx Software Systems, Box 55, Shrewsbury, NJ 07701.

How To Get More Information

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Discounts

There are special discounts available to professors, students, and consultants. A discount is also available on a "trade in" basis for users of competing systems. Call for information.

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3068 systems is designed so that even in the event of a major hardware failure, the Serial Input/Output controller (SIO PCB) is able to report status messages through a modem to the remote service center. These systems are designed so that the self-tests begin from the edge of the system (SCI PCB) and not the center (CPU). This is crucially important if the diagnostics are to function without being crippled by a failure.

If, for example, a severe hardware failure occurs in which the CPU PCB has failed, a diagnostic based on testing from the center (CPU) out will not respond. But a remote diagnostic scheme in which the tests begin at the edge (SIO) and move inward to the CPU will isolate the problem. The technician can download a wide variety of CPU diagnostics through the SIO PCB to isolate the failing component. From error messages the service center technician can devise a troubleshooting strategy. Once the CPU PCB is identified as the culprit, a new CPU can be quickly sent to the site.

In the 2086 and the 3068, each of the key PCBs, the SIO PCB, CPU PCB, and file processor PCB, has its own independent firmware, microprocessor, and local RAM. After power-up, the Intel 8086 on the SIO PCB becomes the diagnostic controller, which is not dependent on the CPU or any other subsystem in order to execute remote diagnostics. The minimum hardware necessary for the SIO to become the diagnostic controller and start verifying the diagnostic kernel after power-up is the following: The SIO's 8086 must be able to retrieve the test program from the SIO's PROMs and store the data in the SIO's local RAMs. Only two of the ten SIO ports (one SCC integrated circuit) need to function for the SIO to be able to report status messages.

Even if the hardware necessary for the minimum diagnostic kernel fails, all is not lost. The necessary hardware for the diagnostic kernel resides on every SIO PCB. On the Altos 2086 system, there are two SIO PCBs (a master and slave). Diagnostics run from the master SIO board. So, if the failed unit does not respond to the downloaded code from the service center computer, this indicates to the service center technician that the master SIO has failed. Now, the slave SIO can be repinned as the master SIO. Remote diagnostics can then be up and running again.

This is not a complete solution to the diagnostic dilemma that calls for failing hardware to troubleshoot itself. If the power supply of the system fails, or if the system is swallowed up by an earthquake, any remote diagnostic scheme will not work. But fortunately, most hardware failures are not catastrophic, and there is usually enough working hardware to identify the failing area. A remote diagnostic scheme designed into a system architecture of independent PCBs that self-test from the edge to the center provides the best of all possible opportunities to fix failures in the field.

CARL STRASEN
San Jose, CA

CALL FOR PAPERS

Collegiate Microcomputer, a journal begun in February 1983, is a forum for the ex-

(continued)

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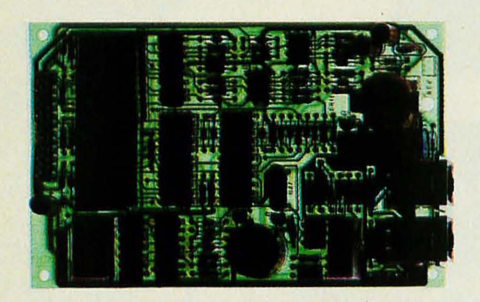
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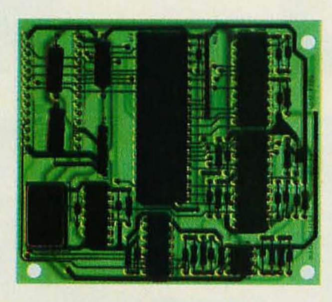
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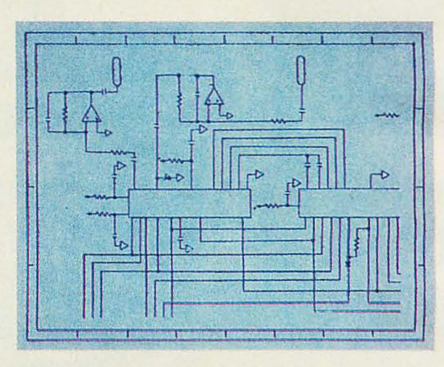
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LETTERS

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BRIAN J. WINKEL, EDITOR
Collegiate Microcomputer
Rose-Hulman Institute of Technology
Terre Haute, IN 47803

MAKING RS-232C CONNECTIONS UNIVERSAL

I'm afraid that the scheme proposed by Pete Klammer (Letters, October 1985, page 22) to make RS-232C connections universal will not work. To see why, let us ignore the control lines in an RS-232C setup and concentrate our attention on the two data lines, which serve as the simplest example that will demonstrate the phenomena involved.

The RS-232C standard states that the female connector shall be associated with data communications equipment (DCE); transmitted data will be on pin 2 and received data will be on pin 3.

Similarly, the male connector shall be associated with data terminal equipment (DTE). Transmitted data will still be on pin 2 and received data on pin 3.

From the point of view of the DTE, it sends data to the DCE on pin 2 and receives data from the DCE on pin 3. The DCE sends data to the DTE on pin 3 and receives data from the DTE on pin 2. This standard allows any data terminal equipment to be connected to any data communications equipment directly, maintaining compatibility of connections.

However, if all equipment were to be considered similar, and hermaphroditic connectors were used, a problem would arise. The problem would be that all units (according to Mr. Klammer's scheme) would use the same pin for a given function (let's say pin 2 to send data and pin 3 to receive). Now we could not connect *any* two pieces of equipment together directly, since each unit's transmit line would be connected to the other unit's transmit line, rather than to its receive line.

(continued)

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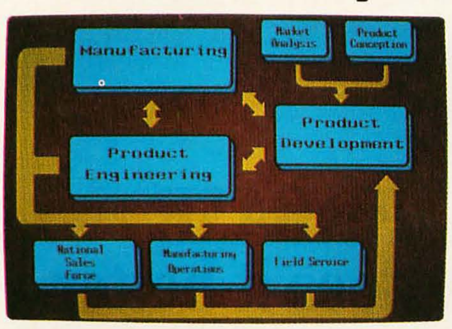
What's more, with the new 3.0 PC Paintbrush, you can draw rounded boxes, rubber band curves and circles, and edit pictures many times larger than the screen.

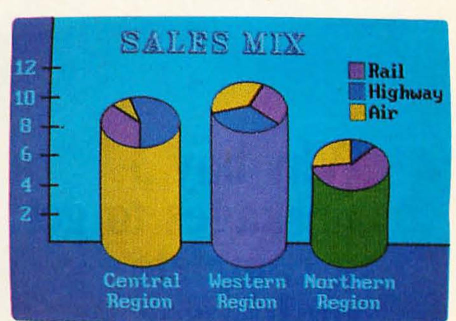
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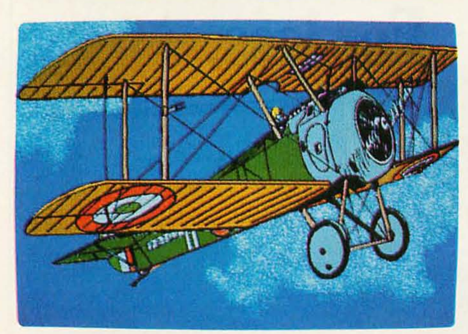
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At the very least, a crossover connector *would have to* be used in all cases.

Furthermore, the use of such crossover connectors creates another, even more subtle, problem. Suppose an extension cable is needed. Since all units require crossovers and all connectors are the same, in practice all cables will contain crossovers. Then, adding an extension cable to an already existing cable will result in *two* crossovers, which bring the same (rather than the complementary) functions together again (i.e., transmit is again connected to transmit). The fact that all cables have identical connectors at both ends would make it impossible to distinquish a straight-through extension cable from a "normal" crossover cable without making continuity checks.

With the current scheme, crossover cables are required only when both ends have the same kind of connector (male or female); a cable with a male connector at one end and a female at the other is a straight-through extension cable.

I agree with Mr. Klammer that the current standard is not perfect; nevertheless, after considering the alternative I have come to the conclusion that it seems to be the best compromise among many conflicting factors.

HOWARD MARK
Suffern, NY

COMPARING THE MOTOROLA 68000 AND INTEL iAPX86

It was intriguing to note the comparison G. Michael Vose made of the Motorola 68000 and Intel iAPX86 families ("Intel and Future IBM PCs," *Inside the IBM PCs*, Fall 1985, page 4). I agree with his first and second conclusions, especially that the "open, flexible architectures" of the M68000 family leaves more room for "innovations in software" on the part of programmers, and that such innovations do indeed "keep our industry vital." It seems to me that Mr. Vose glossed over one aspect of the comparison that, I feel, should have influenced his third conclusion.

The "rigid and formal" architectures of the iAPX86 that realize more fixed solutions in hardware also produce more standardization. While standardization may seem like a restraint to the inventive programmer, it is a boon to the commercial software producer, who must create programs that run on many machines.

I think that software standardization should be the overwhelming consideration in Mr. Vose's third conclusion about which family will dominate the "classic single-user microcomputer." It is the iAPX86 family that will likely continue to support the vast majority of standard end-user programs that "we all want on our desk or at home to play and tinker with."

Of course, that conclusion may depend on who you consider "we all." If the emphasis is on "we," i.e., computer professionals like the editors and contributors of BYTE, then the flexibility of the 68000 might be decisive. However, if the emphasis is on "all," don't forget that the vast majority of single users are not programmers but commercial program end users. I think this point is often forgotten amidst the professional enthusiasm at BYTE.

WILLIAM S. JOHNSON
Palo Alto, CA

(*continued on page* 360)

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Microsoft languages speak for themselves.



Loud and clear.

Microsoft has been the language leader from day one. From the world's favorite BASIC to the systems languages software developers prefer. No one else has put so much programming power on so many micros.

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Our interactive debuggers are another Microsoft edge. Now you can debug the object code using the source language. Easier debugging lets you spend more time creating.

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Microsoft C

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Jim Bean, Peachtree Software.

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Our optimizing compiler lets you squeeze the maximum out of your machine with minimum effort. Tighter code runs faster. And virtually every program will run faster with Microsoft's C Compiler than with any other MS-DOS compiler.

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A bundle of other features can save you programming time. There's inter-language calling support. So you can use existing library routines. Unsurpassed XENIX compatibility. And documentation that reviewers have praised for its clarity and thoroughness.

If Microsoft C amazes you, don't be surprised. After all, our C is the choice of the leaders. Companies like Lotus.® Ashton-Tate. And IBM.®

Microsoft C Compiler Version 3.0 for MS-DOS

Microsoft C Compiler
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- Can mix models with NEAR and FAR pointers.
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- Library routines implement most of UNIX™ System V C library.
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  - —8087/80287 coprocessor support.
  - —Alternate math package provides extra speed without an 8087/80287.
- Link your C routines with Microsoft FORTRAN (version 3.3 or higher), Microsoft Pascal (version 3.3 or higher) or Microsoft Macro Assembler.
- Supports MS-DOS pathnames and input/output redirection.
- File sharing, record locking and file locking are supported.
- Do source level debugging with the Symbolic Debug Utility, available separately with Microsoft Macro Assembler.

Library Manager
- Create, organize and maintain your object module libraries created with Microsoft languages.

Object Code Linker
- Simple overlay linker combines relocatable object modules created using Microsoft languages into a single program.
- Link very large programs (over 1 megabyte) using overlays.

Microsoft EXE File Compression Utility
- A new utility to compress sequences of identical characters from an executable file and optimizes the relocation table.

Microsoft EXE File Header Utility
- Display and modify EXE file header, allowing you to tune the stack size and initial memory allocation.



Macro Assembler

The quickest. Bar none.

Our Macro Assembler has long been the most complete package on the market. Now it's also the fastest. Three times faster than before. And faster than anyone else. Period.

Of course, it's still the most powerful assembler on the market. It supports the standard 8086/8087 opcodes. And the new 186/286/287 instruction set. So you can make the most of the new machines.

Debugging is quicker, too. Thanks to our interactive symbolic debugger, SYMDEB. Now you can refer to variables and source code instead of getting lost in hex dumps. And this debugger also works with Microsoft languages like C, FORTRAN and Pascal. So now you can set breakpoints and trace execution—using source code for reference.

SYMDEB is just part of our complete set of utilities. Tools that make programming as fast as it should be. There are the linker and library managers you'd expect. Plus a new version of MAKE, our maintenance utility, with improvements like macro expansions and inference rules.

We've also revised the manuals. Our new Macro Assembler has a lot to offer, so we added more examples. Now our manuals are not only thorough, they're clearer than ever before.

For quick development and assembly, the choice is obvious. Microsoft. There's nobody faster.



The Macro Assembler's symbolic debugger lets you debug Microsoft FORTRAN programs at either the source or object code level. Set break points, observe the contents of variables and expressions, and examine the contents of the stack.



Microsoft Macro Assembler Version 4.0 for MS-DOS

Macro Assembler
- Fastest macro assembler for MS-DOS computers.
- Supports the 8086/8087/8088 and the 186/286/287.
- Define macros.
- Conditional assembly.
- Optional case sensitivity for symbols.
- 100% upward compatibility from earlier versions of both the Microsoft and IBM Macro Assemblers.

Interactive Symbolic Debug Utility
- Source level debugger for programs written in Microsoft Macro Assembler, C Compiler, FORTRAN, and Pascal.
- Screen swapping helps debug highly visual applications.
- Set breakpoints on line numbers and symbols.
- Single step to follow program execution.
- Disassemble object code.
- Display and modify values.
- Full I/O redirection.

Program Maintenance Utility
- Rebuilds your applications after your source files have changed.
- Similar to UNIX MAKE utility.
- Supports macro definitions and inference rules.

Library Manager
- Create, organize and maintain your object module libraries created with Microsoft languages.
- Set page size from 16 to 32678, to create compact and granular libraries.

Object Code Linker
- Simple overlaying linker combines relocatable object modules created using Microsoft languages into a single program.
- Load Map generation.
- Specify from 1 to 1024 segments.

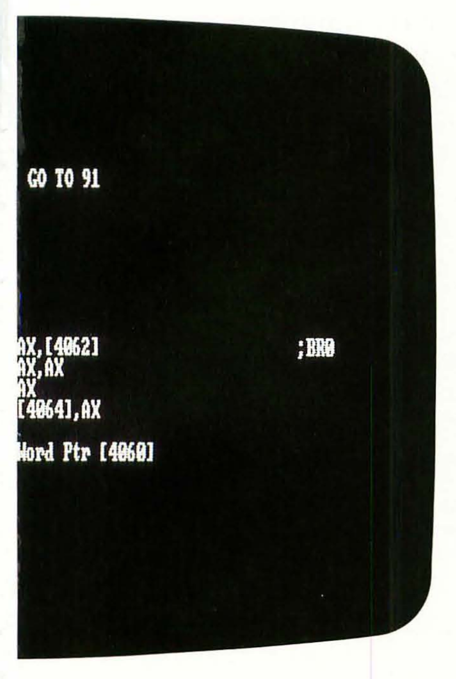
Cross-Reference Utility
- Creates a cross-reference listing of the definitions and locations of all symbols used in an assembly language program, which makes debugging programs easier.

Microsoft EXE File Compression Utility
- Packs EXE files for smaller size on disk and faster loading at execution time.

Microsoft EXE File Header Utility
- Display and modify EXE file header, allowing you to tune the stack size and initial memory allocation.

FORTRAN

The overwhelming favorite.



View the FORTRAN source code. Set a break point at line #14. Run the program **(g)** *and use the expression evaluator* **(?)** *to examine the contents of a variable. Then use the trace command* **(t)** *to observe the program flow.*

Microsoft FORTRAN Compiler Version 3.3 for MS-DOS and XENIX 286

Microsoft FORTRAN Compiler
- Implements most ANSI 77 standard features, plus extensions.
- Easily port mainframe/minicomputer programs with little or no modification.
- Overlay support in the compiler and linker.
- Common blocks and arrays greater than 64K.
- Supported by the largest number of third party libraries.
- Includes a full set of math libraries to select from:
  - 8087/80287 emulation.
  - 8087/80287 coprocessor support.
  - Floating Point without 8087/80287.
  - BCD Floating Point.
- Conditional compilation.
- Link your FORTRAN routines with Microsoft C Compiler (version 3.0 or higher), Microsoft Pascal (version 3.3 or higher), and Microsoft Macro Assembler.
- MS-DOS 3.1 network support and IBM local area network support.
- Source code compatible between MS-DOS and XENIX 286.
- Do source level debugging with the Symbolic Debug Utility, available separately with Microsoft Macro Assembler.

Object Code Overlay
- Simple overlay linker combines relocatable object modules created using Microsoft languages into a single program.
- Link very large programs (over 1 megabyte) using overlays.

Library Manager
- Create, organize and maintain your object module libraries created with Microsoft languages.

Microsoft EXE File Compression Utility (MS-DOS only)
- A utility to pack EXE files for smaller size on disk and faster loading at execution time.

Microsoft EXE File Header Utility (MS-DOS only)
- A utility that allows you to display and modify the fields in EXE file headers.

How did Microsoft FORTRAN get so popular?

It could be the mainframe compatibility. Our compiler makes porting applications a cinch with overlays and the ANSI features you need.

It could be our support for arrays and COMMON blocks larger than 64K. So you can tackle mainframe-size problems.

It might be the shelves and shelves of third party support libraries. No other FORTRAN comes close.

It could be the extensive math support. Our collection of math libraries is simply the largest available. Tackle real problems with direct 8087 support or emulation. Use IEEE floating point or—for extra speed—the altmath package.

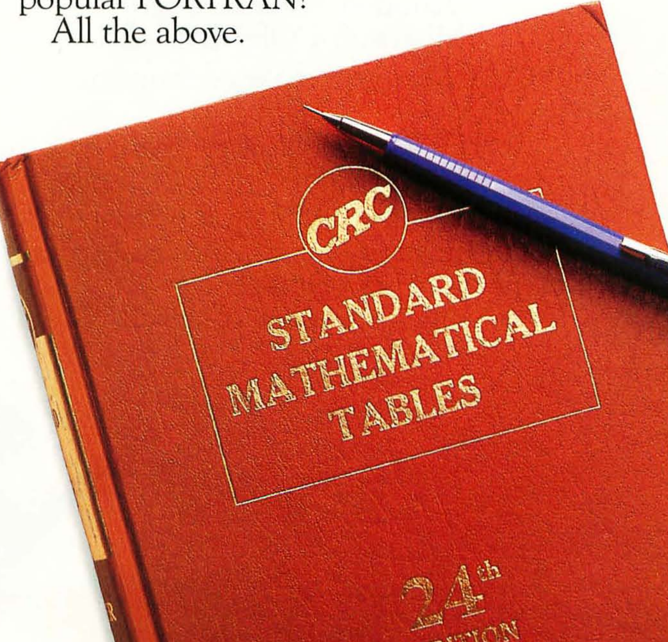
It could be the comprehensive set of utilities. A powerful linker and library manager combination. Plus tools like EXEMOD and EXEPACK. Standard.

It could be the XENIX and MS-DOS source-level compatibility. Or the direct interlanguage calling to Microsoft C, Pascal, and Assembler. Or the ability to work with our Macro Assembler's symbolic debugger.

It could be the value. Nobody offers a FORTRAN package this complete at this low a price.

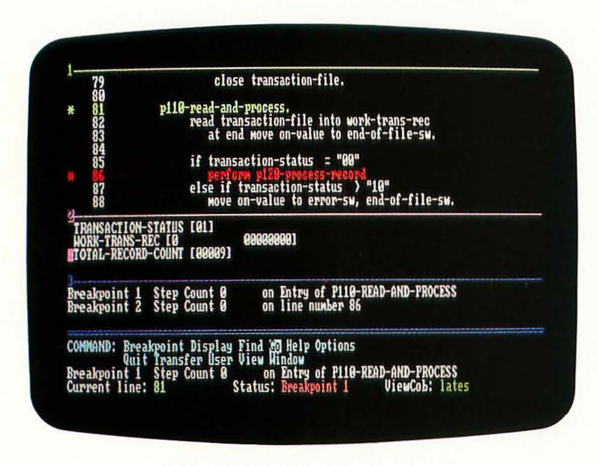
Why is Microsoft FORTRAN the most popular FORTRAN?

All the above.



COBOL

The interactive edge.



Microsoft COBOL gives programs a new look. With dazzling support for interactive programs, and more. Our new COBOL Compiler brings applications to life in several ways.

Our extended screen section lets you create programs that you'd never thought could be written in COBOL. Quickly, easily.

Performance is top notch as well. Our ISAM lets your applications blaze through files. After all, our ISAM is the fastest on the micro market.

Of course, Microsoft COBOL complies with the ANSI standard. Amazing performance, without runtime license fees. No wonder our COBOL is the choice of manufacturers like IBM, AT&T, DEC, HP and Wang.

Another breakthrough: Microsoft COBOL Tools.

Only Microsoft makes debugging this easy.

Our COBOL Tools is the perfect companion to our COBOL Compiler. A complete set of utilities. Tools that make debugging and maintenance easier than you'd thought possible.

The star of the show is ViewCOB, our advanced interactive debugger. ViewCOB lets you control and examine programs easily. Open windows on variables and procedures while watching the source code execute. ViewCOB is simply the most advanced COBOL debugger you can get.

Microsoft COBOL and COBOL Tools. An unbeatable team.

Microsoft COBOL Compiler Version 2.1 for MS-DOS and XENIX 286

Interactive extended screen section
- Cursor positioning, auto skip, and automatic data field formatting.
- ACCEPT or DISPLAY a screenful of data with a single statement.

Fast multi-key ISAM
- Split keys, alternate keys, duplicate keys.
- Benchmark results of 2500 reads, writes and rewrites to an ISAM file.

	Microsoft COBOL	Micro Focus native code	Ryand McFarland COBOL 2.0
Seconds	846	4073	1177

Source code compatible between MS-DOS and XENIX 286.

Microsoft COBOL Tools for MS-DOS and XENIX 286
- Cross reference utility speeds program development.
- Menu generator allows you to use Microsoft Word style menus in your program.
- Mouse interface allows you to create programs that use the mouse (MS-DOS only).

Advanced interactive debugger
- Use trace, single step, and execution history to follow the program flow.
- Observe the contents of variables and memory while the program is executing.
- Set breakpoints and change the contents of variables.
- Trap fatal runtime errors.
- Use the menu driven windowing user interface with on-line help.



Pascal

When you've outgrown the others.

Only Microsoft Pascal is powerful enough to push the outer limits of your PC. With more features than any other Pascal compiler.

Microsoft Pascal handles large programs with ease. No 64K boundaries —use multiple code and data segments up to a megabyte. Create your own libraries of pre-compiled Pascal modules. Separately-compiled modules can be overlayed or linked together into one file.

Our Pascal comes complete with the BCD and 8087 math libraries you'd expect. Including an IEEE floating point emulator. And Microsoft Pascal is completely compatible with IBM's Local Area Network and MS-DOS Networking. Added features without added costs.

Microsoft Pascal also supports direct interlanguage calling to modules written in Microsoft C, or Microsoft FORTRAN or assembly language. And it's compatible with our Macro Assembler's symbolic debugger. So you can track down those subtle logic errors with breakpoints instead of guesswork.

Microsoft Pascal. Nobody does it better.

Microsoft Pascal Compiler Version 3.3 for MS-DOS and XENIX 286

Microsoft Pascal Compiler
- Separate module compilation.
- Large program support; up to 1 megabyte code and multiple data segments.
- Overlay support.
- Contains four math libraries to choose from:
  - —8087/80287 coprocessor support.
  - —Fast IEEE floating point.
  - —8087/80287 floating point emulation.
  - —BCD decimal math.
- Link in your routines or third party software routines written in Microsoft FORTRAN (version 3.3 or higher), Microsoft C Compiler (version 3.0 or higher) or Microsoft Pascal (version 3.3 or higher), or Microsoft Macro Assembler.
- Source code compatible between MS-DOS and XENIX 286.
- Supports file sharing and record and file locking.
- Supports MS-DOS pathnames and input/output redirection.
- Do source level debugging with the Symbolic Debug Utility, available with the Microsoft Macro Assembler.

Library Manager
- Create, organize and maintain object module libraries created with Microsoft languages.

Object Code Linker
- Simple overlay linker combines relocatable object modules created using Microsoft languages into a single program.
- Link very large programs (over 1 megabyte) using overlays.

Microsoft EXE File Compression and File Header Utility (MS-DOS only)
- Compress, modify and examine executable files and their headers.

Microsoft QuickBASIC

BASIC just got faster.

Microsoft's new QuickBASIC Compiler gives your programs an extra burst of speed. Without sacrificing BASICA compatibility. Your compiled programs will run just like before, only faster. Three to ten times faster. With little or no modification.

QuickBASIC makes structured programming a snap. New extensions like alphanumeric labels make programming easier too. And separately compiled subprograms let you test and compile individual routines one at a time.

Microsoft QuickBASIC. All the features of a compiler, with BASICA compatibility to boot.

Microsoft QuickBASIC Compiler Version 1.0 for IBM PC and Compatible Computers

BASICA compatibility
- Sound statements including SOUND and PLAY.
- Graphics statements including WINDOW, VIEW, DRAW, GET, PUT, LINE, CIRCLE, LOCATE and SCREEN.

Results of the Sieve benchmark	BASICA	QuickBASIC
seconds per iteration	71	0.5

Structured programming support
- Subprograms can be called by name and passed parameters. Both local and global variables are supported.
- Multi-line functions can be called by name and return a value.
- BASICA structures are supported including WHILE/WEND, IF/THEN/ELSE, FOR/NEXT, GOSUB/RETURN, and event handling.

Alphanumeric labels
- Can be used to make your programs more readable. Line numbers are not required but are supported for BASICA compatibility.

Modular programming support
- Separate compilation allows you to create compiled BASIC libraries to use and reuse in your programs.
- Named common gives you control of data flow between individual modules.

Large program support
- Code can use up to available memory.
- Data can use up to 64K RAM.

F·I·X·E·S A·N·D U·P·D·A·T·E·S

UPDATES

BetterBASIC 2.0

Subsequent to Art Huston's review of Summit Software's BetterBASIC version 1.1 (October 1985, page 277), we learned of version 2.0, scheduled for shipment at the beginning of 1986 and providing the following enhancements:

Increased IBM PC BASICA compatibility: Random file I/O, program interrupts, assembly-language calls compatible with BASICA, error handling, dynamic strings, dynamic arrays, CHAIN with COMMON, BLOAD and BSAVE, and FIELD structure for random I/O.

The only BASICA statements not now supported by BetterBASIC are MOTOR, PEN, ON PEN, ON STRIG, STRIG, STICK, and VARPTR. A translator now allows BetterBASIC to read tokenized BASICA programs directly.

New features: Support for arrays to the limit of memory, support for virtual arrays to 4 gigabytes, multiple display windows, support for graphics and sound, user-programmable support for foreign-language character sets, TRACE facility for continuous or stepwise program debugging, plus the capability to set breakpoints and to continue execution of programs after modification of data or program code.

BetterBASIC version 2.0 also allows programmers to eliminate declared variables or to globally change the name of a variable in an existing program. Version 2.0 uses the IEEE format for floating-point numbers to both improve execution speed and ensure compatibility with BASICA.

Summit Software also has a new address and phone number: 106 Access Rd., Norwood, MA 02062, (617) 769-7966.

Sold in the USA

A February What's New item (page 402) describing TDI's Modula-2/ST and UCSD Pascal for the Atari 520ST listed an address in England and prices in pounds. Soon after that page went to press, we found that both packages are available in the U.S. Each program costs $79.95. Contact TDI Software, 10410 Markison Rd., Dallas, TX 75238, (214) 340-4942.

PC Paintbrush

PC Paintbrush, which Robert Tinney used to create the cover of our November 1985 issue, has been released in a new edition.

ZSoft Corporation (1950 Spectrum Circle, Suite A-495, Marietta, GA 30067) says version 3.0 has 16 added features, including automatic curve drawing, variable font-stroke widths, rounded boxes, increased speed, rubber-band circles, lasso capability, editing of pictures larger than the screen, and fully adjustable palettes. The user interface and the screen remain "almost the same."

BYTE'S BITS

Report on Word Processors

The PC Technical Group of the Boston Computer Society has released a report covering scientific/technical word-processing and typesetting programs for the IBM PC, XT, and AT. According to the BCS, the summary represents several hundred hours of evaluation and comparison.

"IBM PC & Compatibles: Technical Word Processor Review Summary" costs $8, which covers the cost of reproduction and mailing. For more information, contact Carl A. Hein, Dunster House, Apt. 7, Swanson Rd., Boxborough, MA 01719.

FIXES

Two Books One and the Same

Addison-Wesley's Marketing Coordinator has informed us of an error in "An Annotated Bibliography of Recent Books," which appeared in our 1985 special issue, *Inside the IBM PCs* (page 14). One book was listed twice: once under its correct title, once under a title it had prior to publication. The correct title is *The IBM Personal Computer from the Inside Out* (ISBN 0-201-06896). It is written by Murray Sargent III and Richard L. Shoemaker. Although *Interfacing the IBM Personal Computer to the Real World* is listed in Bowker's *Books In Print*, Addison-Wesley said it has never published that title and has no plans to do so.

True BASIC and the Math Coprocessor

In a review of True BASIC (May 1985, page 279), it was stated that the language can automatically sense and use the Intel 8087 coprocessor. True BASIC Inc. sent us the following information.

Version 1.0 of True BASIC for the IBM Personal Computer does not correctly detect the Intel 80287 numeric data processor. Owners of version 1.0 can get the software fixed by sending the original disk to the company's Customer Support Dept., 39 South Main St., Hanover, NH 03755. Mark "Attn: 80287 patch" on the package, and don't forget to include your return address.

How to Access and Use BYTEnet Listings

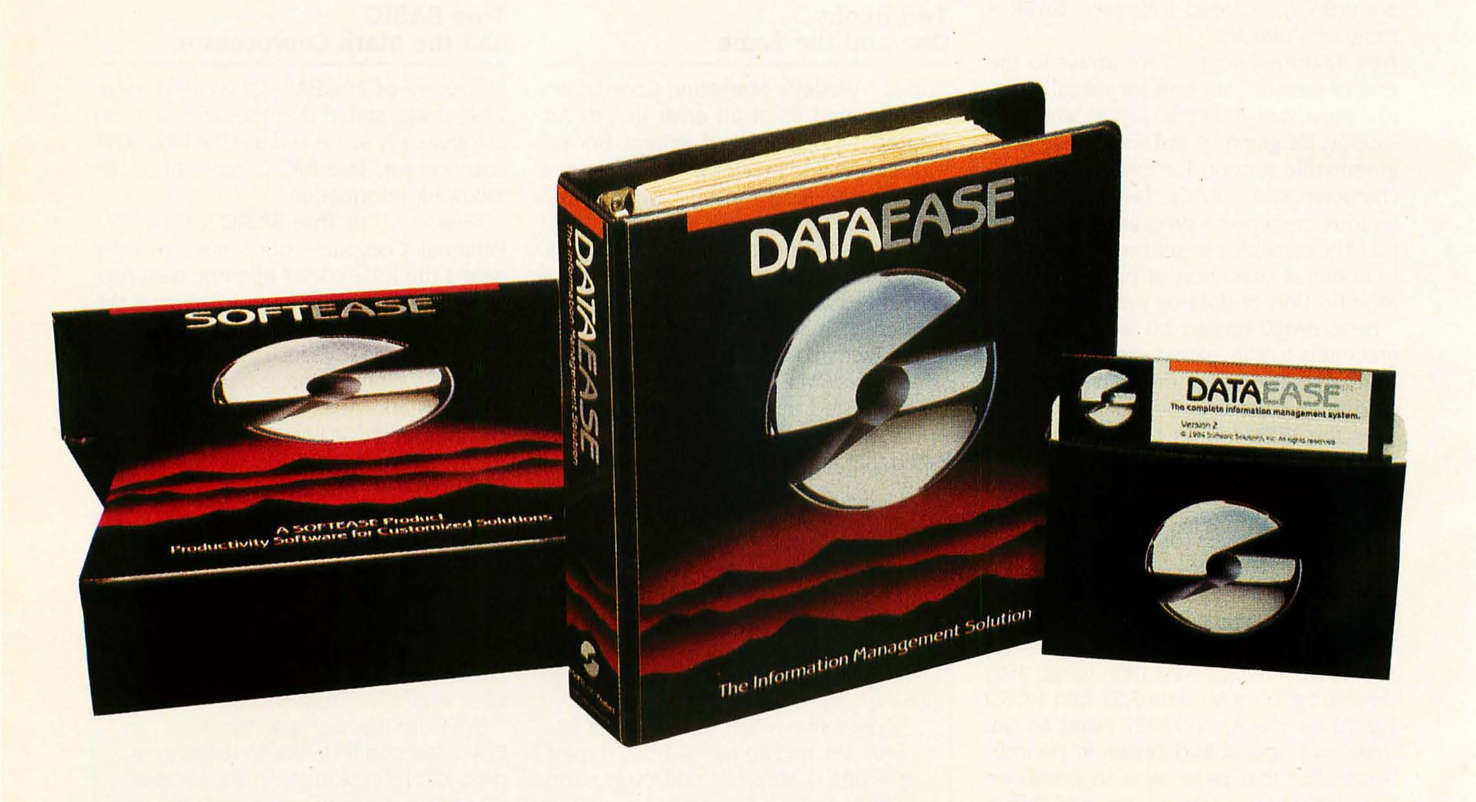
To access BYTEnet Listings, call (617) 861-9764. When you get the carrier tone, enter two or three carriage returns so that our software can determine your operating parameters.

Optimum modem settings are 8 bits, 1 stop bit, and no parity at full duplex, or 7 bits, 1 stop bit, and even parity at half duplex. Acceptable operating speeds are 300 or 1200 bps. At this time, BYTEnet Listings does not support 2400-bps transmissions.

The BYTEnet Listings software itself is menu-driven. Programs may be downloaded using ASCII, Kermit, Tele-Link, and XMODEM protocols.

BYTE listings are also available on BIX. After connecting with the system, type join listings at the main prompt. (For more information on BIX, phone (800) 227-2983 between 8:30 a.m. and 4:30 p.m. Eastern time.)

YOU CAN'T GET A GOOD FEEL FOR A SOFTWARE PACKAGE FROM AN AD.



If you're searching through the ads in this magazine for the "right" software package, good luck.

Let's say you're looking for a data base manager. You read a dozen ads. Each one offers its list of features. Each one talks about the ideal combination of power and ease of use. And each one promises to "solve your problems", "answer your needs", or both.

Don't Believe Anybody
We could make the same claims for DATAEASE. Even before Release 2.5, tens of thousands of users made DATAEASE the corporate data base standard. We could tell you that they found DATAEASE to be an invaluable productivity tool because of its fully relational capabilities, full screen editor and unique combination of menus and commands. But don't believe us.

More than 100 reviewers from major publications agree with our productivity claims. Data Decisions called DATAEASE "perhaps the most effective blend of ease-of-use and performance available for PC users to date." But don't believe the reviewers.

Application developers, MIS/DP/IC managers, and all kinds of other users from Fortune 1000 companies throughout the country have reached strikingly similar conclusions. A user at General Instruments reports that "those same factors that make DATAEASE preferable for non-programmers — ease of use and speed of development — make it the program of choice for many technical types, too." But don't even believe other users.

Nobody knows what you know.
Even if all these people are absolutely right about DATAEASE, does that mean it's the right product for you?

The best way to know if DATAEASE fits your needs is to get your hands on our free sample diskette. Fifteen minutes with the sample will give you a feel for our best DATAEASE yet — Release 2.5. It has features that appeal to all users; from developers to data entry people: A complete procedural language; quick reports at the press of a button; a direct interface to Lotus 1-2-3; the ability to move rapidly from file to file on a common piece of data; and built-in scientific, mathematical, financial, date, time, and string functions.

Productivity takes more than a good product.
It takes a good company, too. Buying a software package is the beginning of a relationship. Technical support, product upgrades, special corporate and dealer programs and informational seminars should all be part of this relationship. If the only thing you get is a product, forget about productivity. At Software Solutions, you find more than a product. You find software solutions.

Find out for yourself.
The advances in DATAEASE's Release 2.5, and the support behind it, offer you practical advantages that leave all the other data base managers far, far behind — including R:Base 5000(TM) and dBase III(TM). But don't believe us. Call or write for information and your free sample diskette today.



CALL OR WRITE FOR YOUR FREE SAMPLE DISKETTE.

Send information and a free DATAEASE sample diskette for my PC (check one):

☐ IBM ☐ WANG ☐ DEC ☐ TI

Include materials relating to:

☐ Corporate Client ☐ Retailer
☐ MIS/DP/IC Professional ☐ VAD
☐ Other ______________

Name: ______________

Title: __________ Phone: __________

Company: ______________

Street: ______________

City: ______ State: ____ Zip: ______

Mail to: BYT 3/86

Software Solutions, Inc.,
12 Cambridge Drive,
Trumbull, CT 06611 Telex: 703972

Don't like samples? Then just call us. We'd be happy to talk about your information management needs and advise you.

800-243-5123

Scandinavia
West Soft A/S, Alesund, Norway; (47) 71-41141

Switzerland, France
Softsource, S&A 1222 Vesenaz, Switzerland; 022-3518-55

United Kingdom
Sapphire Systems, Essex; 01-554-0582

West Germany, Austria
M&T Software Verlag, Munich; 089-4613-0

Inquiry 317

Drawing and Painting Program for Amiga

Electronic Arts has released a graphics package for drawing and painting with the Amiga. Deluxe Paint, first in a series of arts software for the Commodore machine, has 20 drawing tools, 7 painting modes, 14 special-effects tools for brushes, 10 built-in brush shapes, and a palette of 32 colors (out of a possible 4096).

Deluxe Paint's drawing tools include magnify and zoom functions that let you split the screen into a normal image and a magnified portion of the image. As you zero in on and alter details in the magnified window, changes are reflected in the normal window. Another tool lets you customize paintbrushes. Anything you can draw can be framed, picked up, and used as a new paintbrush.

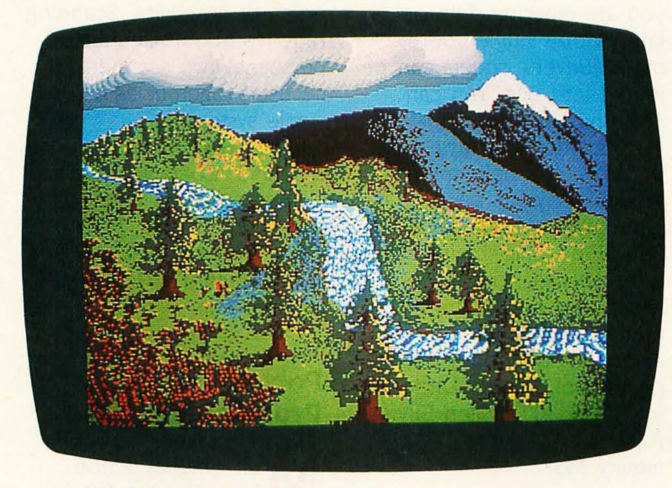
The package offers four types of brushes: circles, squares, dots, and airbrush. You can rotate any brush 360 degrees, flip it vertically or horizontally, stretch it into new shapes, or shear its angles. Shading and smearing capabilities help with texture and nuance.

You can create animation effects with what Electronic Arts calls "color cycling"—cycling a variety of colors through a static picture to concoct the illusion of motion. You can use three different color cycles and speeds per picture.

Five color controls let you handle the mix of red, green, and blue and adjust the hue and brightness of each color. The software enables the Amiga to automatically generate the shades of color between any two pigments you pick.

Deluxe Paint, priced at $79.95, is designed to work with two other programs still in the Electronic Arts workshop, Deluxe Print and Deluxe Video Construction Kit (reportedly slated for April release). It requires 256K bytes of RAM and Kickstart 1.1. Contact Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404, (415) 571-7171.
Inquiry **550.**





Images created with Deluxe Paint and an Amiga.

Video Controller Combines Popular Standards

Video-7's VEGA is an enhanced graphics adapter for the IBM PC, XT, AT, and compatible personal computers. VEGA uses surface-mounted CMOS VLSI technology, with four custom chips and 28 integrated circuits, to provide four video-display modes, 12 graphics/text-display modes, and 256K bytes of RAM on a 4.2- by 5-inch short-slot card.

The four video-display modes offered by VEGA are the functional equivalents of the IBM Enhanced Graphics Adapter, the IBM Color Graphics Adapter, the IBM Monochrome Display Adapter, and the Hercules Graphics Card. Each mode is 100 percent compatible with the corresponding popular standard. You can move between enhanced color, color, and monochrome modes using a toggle switch on the back panel of your computer.

The board has 10 graphics and 8 alphanumeric display modes. This includes a high-resolution color display with 640 by 350 pixels and 16 colors from a 64-color palette. A RAM-based character generator allows up to four sets of 256 different characters or two sets of 512 different characters for multiple character fonts. Each character cell can be up to 32 dots high and 8 dots wide. The board also lets you split your screen horizontally when in EGA mode.

The VEGA has a DE-9 female connector, a 32-pin "feature connector," RCA phono connectors, and a 6-pin keyed light-pen connector. It will run with a monochrome display adapter or a color-graphics adapter in another slot. It

(continued)

sells for $599 and is also marketed by Quadram as the QuadEGA. Contact Video-7 Inc., 550 Sycamore Dr., Milpitas, CA 95035, (408) 943-0101.
Inquiry 551.

MS-DOS Portable from Sony

Sony's IBM PC-compatible computer, the M35, is a 13-pound unit with a CMOS 80C88 microprocessor, 640K bytes of RAM, and two 3½-inch 720K-byte floppy-disk drives. The portable also has serial and parallel ports, composite video and analog RGB ports, and an internal 300-bps modem. Options include a 25-line LCD screen and a 5¼-inch floppy-disk drive.

Sony says its MS-DOS-based machine can be connected directly to its dedicated word processors.

The M35 will have a list price of approximately $2695. Contact Sony Communications Products Co., Sony Dr., Park Ridge, NJ 07656, (201) 930-6432.
Inquiry 552.



Sony's MS-DOS *portable, the* M35.

Spreadsheet for the Amiga

Lattice has developed an electronic spreadsheet for the Commodore Amiga called Unicalc. The software provides a processing area of 256 columns by 8192 rows, dual-window capability, context-sensitive help screens, floating dollar signs, negative balance indicators, and punctuated numbers. Cells can contain numeric data, algebraic formulas, or text.

Unicalc has a library of algebraic and conditional functions. Calculations can be made automatically as you are entering data or later with a single command. Several sheets can be joined into one. You can customize the column widths, titles, displays, prompts, and help screens.

Lattice says its package is compatible with Lotus 1-2-3, SuperCalc, and similar software. Unicalc costs $79.95, which also gets you a manual, telephone support, and a 30-day money-back guarantee. Contact Lattice Inc., POB 3072, Glen Ellyn, IL 60138, (312) 858-7950.
Inquiry 553.

Optical Scanner/Printer

Image Communications is selling an optical scanner/printer for the IBM PC and the Apple Macintosh. Called Image Blue, it can digitize and print images (on electrostatic paper) at a resolution of 200 dots per inch. The scanner can transmit information at up to 9600 bps over its serial port or up to 2400 bps through its integral telephone jack.

Optional software ($80) lets you load images into a PC or Mac and manipulate the images using PC Paintbrush or MacPaint. Scanning requires about 3 minutes per page. Two scanners can be used together as a facsimile system.

Image Blue has a list price of $1295. Contact Image Communications Inc., 640 West Putnam Ave., POB 4809, Greenwich, CT 06836-0086, (203) 661-0607.
Inquiry 554.

Polyglot Word Processor

Multi-Lingual Scribe, from Gamma Productions, is a word-processing package for the IBM PC. It can type English, Russian, Greek, Hebrew, and Arabic texts and can display all those languages on a single line. The texts are shown with or without accents and vowel points and can be printed on most popular printers. The English font includes most European-language characters.

Selecting a language requires a single function-key command. The processor includes standard word-processing features and offers block move, search and replace, headers and footers, print preview, sub- and superscripts, and unlimited document size. Its formatting commands include columns, centering, proportional spacing, boldface, underlining, mixing small and large fonts, and microjustification. Special features such as wordwrap in both left-to-right and right-to-left modes are also part of Scribe's repertoire. Along with the software, you get keyboard layout charts and press-on keyboard labels for all four foreign languages (including both standard and mnemonic for Hebrew).

A built-in Font Generator utility lets you use on-screen graphics to customize the characters and keyboard layout or to build an entirely new set. You can compose text in either 40- or 80-column mode. The print preview feature lets you see how the text will appear when it is printed. You can also use another word processor and engage Scribe to make that software print proportionally spaced text or to add foreign characters to the files generated by that software.

Multi-Lingual Scribe 2.0 costs $349.95 and requires an IBM PC, XT, or AT, DOS 2.0 or higher, at least 320K bytes of RAM, an IBM or Hercules color-graphics card, and one disk drive. It can print to Epson, IBM Graphics, Okidata (with Plug 'n Play IBM emulation), C. Itoh Prowriter, or NEC 8023A dot-matrix printers.

Contact Gamma Productions Inc., 710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401, (213) 394-8622.
Inquiry 555.

(continued)

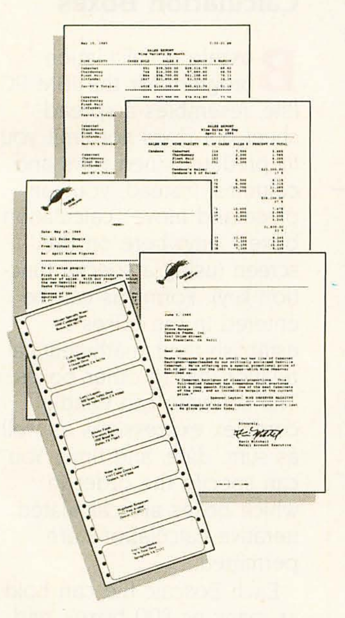
Using Lotus 1-2-3® without Reflex is like driving at night without lights

If you use Lotus 1-2-3 you need Reflex, the Analyst™ because it shows you what 1-2-3 either hides in the dark or can't show you at all. Reflex shows you relationships and inter-relationships in your data that you can't afford o miss.

Reflex includes the best Report Generator for Lotus 1-2-3.

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Reflex gives you five new and different views of what's hidden in your 1-2-3 worksheets.

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Form View lets you create your database. *List* View shows you your data in tabular list form, just like a spreadsheet. *Graph* View gives you instant interactive graphic representations; *CrossTab* View gives you amazing "cross-referenced" pictures of the links and relationships hidden in your data. *Report* View allows you to use information from 1-2-3, and then print out reports in all sorts of different formats.

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With Reflex when you modify a number all your Views — List, Form and Graph — are immediately updated, on-screen.

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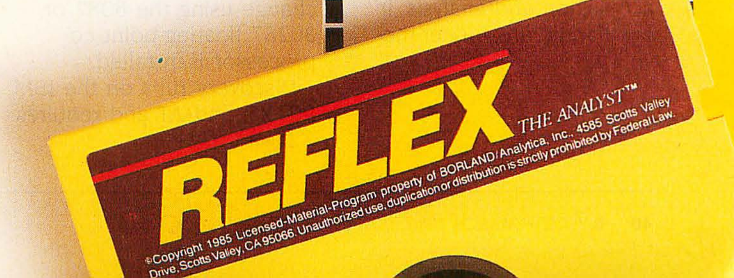
System requirements: IBM® PC, XT, AT, or compatibles. 384K RAM minimum. IBM Color Graphics Adapter®, Hercules Monochrome Graphics Card™, or equivalent. PC DOS® 2.0 or greater. Hard disk and mouse optional.

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Inquiry 46 for End-Users. Inquiry 47 for DEALERS ONLY.



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Flip Puck, Change Type

Metatext from Image Computer Systems converts the dotty font of a dot-matrix printer into letter-quality type. The package consists of software and what Image calls a puck; the puck is approximately the size and shape of a blackboard eraser and, like a mouse, rests on the table next to the computer.

The program resides permanently in RAM. If you want letter-quality type, the software intercepts the characters sent to the printer and converts them into high-resolution plot data.

To switch between draft and letter quality, you flip the puck to the appropriately labeled side. When the "draft" side is up, output goes to the printer in the usual fashion. When the "quality" side is up, Metatext intercepts the characters.

The package works with IBM PCs and compatibles and drives most dot-matrix printers that recognize Epson control codes. No hardware or software modifications are necessary. Metatext contains six fonts and emulates the IBM Graphics Printer. It costs $129. Contact Image Computer Systems, POB 647, Avon, CT 06001, (203) 678-8771.
Inquiry 556.



Metatext print enhancer from Image Computer Systems.

Data-Acquisition Software

Discovery, from Cyborg Corp., is a menu-driven program designed for data acquisition and analysis. It can handle area-under-the-curve calculations, FFTs and smoothing, and instrument control.

Discovery's calculation and signal-processing functions let you build a table of selected values and transfer summary data to Lotus 1-2-3 for further analysis and presentation. You can scroll through graphs of data and zoom in on regions of interest, mark points for calculation, and expand the *x*- or *y*- axis. The program also lets you store sequences of up to 10 operations for repeated use; sequences can loop and trigger from a variety of sources, including time of day, a single keystroke, and a value read from the signal source.

Other operations and functions include integration, differentiation, auto-correlation, cross-correlation, and windowing. Discovery also calculates variance, mean, standard deviation, slope, and change using the 8087 or 80287 floating-point coprocessor if installed.

Discovery runs on the IBM PC, XT, and AT and requires 512K bytes of memory and a hard-disk drive. The program costs $1190. For more information, contact Cyborg Corp., 55 Chapel St., Newton, MA 02158, (617) 964-9020.
Inquiry 557.

Apple-like Laser 128

The Laser 128 is a portable computer that reportedly runs "nearly all" the software for Apple's IIe and IIc. The 12-pound machine houses 128K bytes of RAM, 32K bytes of ROM, a 5¼-inch floppy-disk drive, both a serial and a parallel printer interface, a modem port, and a 50-pin Apple-compatible expansion slot. You can also hook up an additional disk drive, a mouse or joystick, and a monitor.

Like the Apple IIc, the Laser 128 uses a 65C02 processor. The keyboard, which has 10 function keys and a numeric keypad, can be switched between QWERTY and Dvorak layouts. The computer can produce double high-resolution graphics and has 16-color capability. Other features include a built-in speaker with volume control, 40- or 80-column text, and text in inverse or flashing mode. Data transmission can be set at seven rates, ranging from 110 to 19,200 bits per second.

The Laser 128 has a suggested retail price of $479. Two companies are selling the machine. Contact Video Technology (U.S.) Inc., 2633 Greenleaf Ave., Elk Grove Village, IL 60007, (312) 640-1776, or Central Point Software Inc., 9700 Southwest Capitol Highway, Suite 100, Portland, OR 97219-9990, (503) 244-5782.
Inquiry 558.

Calculation Boxes

Boxcalc, a calculation program for the IBM PC line, resembles a spreadsheet but does not limit you to predetermined rows and columns. Instead, you can place and move "calculation boxes" anywhere on the screen (using a special function key). Formulas can be entered in the boxes to establish their mathematical relationship to other boxes. The software can handle complex expressions as well as sum, date, and time. You can specify the order in which boxes are calculated; iterative calculations are permitted.

Each Boxcalc file can hold as many as 800 boxes, and as many as 99 pages of figures and text can be created, stored on disk, and printed. Full replication features are designed to facilitate entering multiple formulas into boxes.

Boxcalc sells for $40 and comes with an instruction manual and without copy

(continued)

protection. A demo sells for $5. Running the program requires 256K bytes, PC-DOS 2.0 or later, and a color monitor. Contact Cotton Software Inc., 2510 Anderson Rd., Suite 364, Covington, KY 41017, (606) 727-1600.
Inquiry 559.

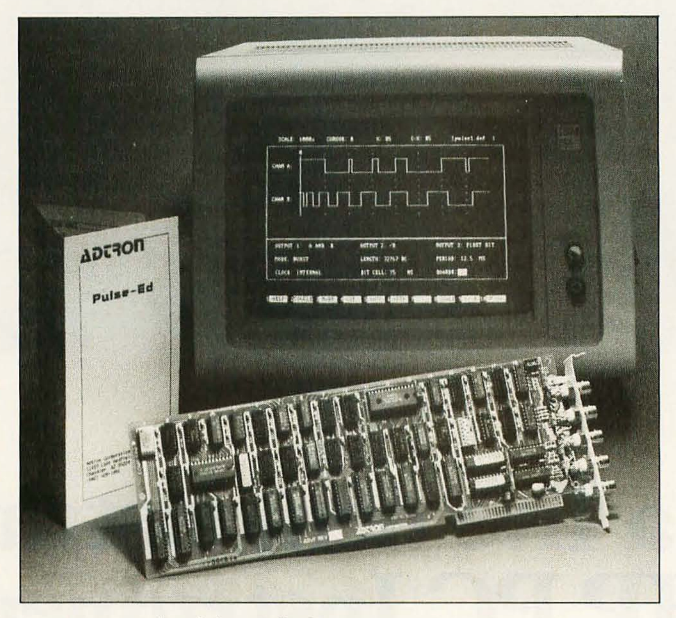
Define Your Digital Waveforms

Adtron's Data Generation System operates with IBM's PC or PC XT to produce user-defined digital waveforms. It consists of a plug-in data-generator board and a full-screen waveform editor. The hardware/software combination is designed to offer the capabilities of pattern, word, and pulse generators.

The system can serve as a signal source for these applications: laboratory data generator, communications data emulator, pseudorandom noise source, automatic test stimulus, and pulse and timing generator.

The editor, called Pulse-Ed, enables you to design, modify, store on disk, and print waveforms. Adtron says the program resembles a text editor in operation and a logic analyzer in appearance. Once you've defined a waveform, you can send it to the board for execution or transfer it to another system via disk or modem. During execution, the board does not require processor support.

Dual-channel operation offers 32,768 bits per channel, bit widths from 50 nanoseconds to 9.999 seconds, and external clock and sync inputs. The system runs on any IBM PC, XT, or compatible with 128K bytes of RAM, one double-sided floppy-disk drive, and MS-DOS 2.0 or later. List price is $2175; quantity discounts are available. Contact Adtron Corp., 11415 East Redfield Rd., Chandler, AZ 85225, (602) 926-1461.
Inquiry 560.



Data-generator board from Adtron's system.

Calculator Kit for the Macintosh

Calculator Construction Set from Dubl-Click Software enables you to design your own calculators, clocks, and calendars and install them as Macintosh desk accessories. No programming is required; you drag parts onto a calculator shell and then "wire" the functions. The package contains mathematical, scientific, business, date/time, and conversion functions.

The kit's box of parts holds various-size keys, switches, LEDs, clock/calendar displays, and a resizable scrolling paper tape that prints to the Imagewriter printer, the Mac Clipboard, or a Mac text file. You can map on-screen calculator keys to any alphanumeric keyboard or keypad (as an alternative to using a mouse).

You can customize calculator cases using MacPaint-style tools for drawing, painting, filling, stretching, and typing. Calculators can be saved as work files, accessory mover files, or self-installing calculator files.

Calculator Construction Set runs on any Macintosh and is Switcher-compatible. List price is $99. Contact Dubl-Click Software, 18201 Gresham St., Northridge, CA 91325, (818) 349-2758.
Inquiry 561.

Utilities for dBASE Programmers

Gryphon Microproducts has developed a set of utilities that expand the memory capability of dBASE from 63 variables to more than 8 million. Called dB/RA, the package consists of 22 commands that can be called directly from dBASE, letting programmers work with databases in memory in the form of arrays.

Gryphon says dB/RA takes advantage of the Lotus/Intel Extended Memory Specification. It has commands for table-lookups and range searches of as many as 100 arrays. Functions include instant screens, pop-up color windows, and Lotus-like menu operations.

The utility set costs $200; a demo is $20. For more information, contact Gryphon Microproducts, POB 6543, Silver Spring, MD 20906, (301) 946-2585.
Inquiry 562.

Gizmo Extends AT Memory

The AT Gizmo is a card that installs between the IBM PC AT's motherboard and 80286 processor and enables PC-DOS applications to use 4.6 megabytes of extended memory. The 3- by 5-inch device remaps addresses that access memory, allowing extended memory to become addressable memory. Extended memory becomes addressable because the AT Gizmo makes all the machine's memory operate in native mode, compatible with PC-DOS. The memory usually accessed in protected mode is accessible from native mode with the card.

The AT Gizmo sells for $295. Contact The Software Link Inc., 8601 Dunwoody Place NE, Suite 632, Atlanta, GA 30338, (404) 998-0700.
Inquiry 563.

(continued on page 399)

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Inquiry 128 for End-Users. Inquiry 129 for DEALERS ONLY.

A·S·K B·Y·T·E

Conducted by Steve Ciarcia

Color Graphics

Dear Steve,

I recently purchased an IBM PC without a video board. I am looking at what is available in color-graphics boards. I have found two bare boards, one from J. C. Computer Inc. in Anaheim, California, and another from Computer Parts Galore in Batavia, New York. Are you familiar with either board?

I will be using a television at first, so I will have to employ an RF modulator. I have one that requires +5 V, but the IBM color-graphics board supplies +12 V. I assume that most of the others also supply +12 V. Is it a minor modification that would be necessary to change my modulator to accept +12 V?

Finally, have you considered a construction article on an IBM PC-compatible video board or perhaps a memory-expansion board?

Bob Dowell
Radcliff, KY

I am not familiar with the two boards you mention, but the one from Computer Parts Galore claims to be like a Persyst board and compatible with the IBM color-graphics board. This seems like a good choice, but don't forget to get the character ROM. I couldn't find J. C. Computer in recent issues of Computer Shopper, *but I did find a C. J. Computers in Anaheim. They sell components to build your own PC but apparently not bare boards.*

Another source of bare boards for IBMs is Micro Mate Associates.

You can pick up the needed +5 V DC for your modulator from pin 5 of the light-pen connector on the color-graphics board.

I don't have any plans to make either an IBM-compatible graphics board or memory-expansion board. There are many of each to choose from, including the bare multifunction board from Computer Parts Galore.

Addresses of the companies mentioned above are Computer Parts Galore, 56 Harvester Ave., Batavia, NY 14020, (800) 431-9008; C. J. Computers Corporation, 2424 West Ball Rd., Suite B, Anaheim, CA 92804, (714) 821-8922; and Micro Mate Associates, POB 742, Station B, Willowdale, Ontario M2K 2R1, Canada. —Steve

P.S. I have a super graphics-board project in the works.

Striated Letters

Dear Steve,

I have just purchased a Tandy 1000. It works great, but I'm not too crazy about the display—the letters appear striated. I've tried various monochrome monitors, but they all give the same striped look. Is there a monitor that I can use with the 1000 that will give solid letters on the screen?

I've seen the IBM 5151 monochrome monitor hooked to an IBM PC, and it looks wonderful. Unfortunately, the monitor connector on the PC is not the same as on the Tandy 1000. Do you know if I could make some sort of adapter to hook the 5151 to the 1000, and, having done that, will I get the same sharp letters I have seen on the PC?

Duff Kennedy
Santa Barbara, CA

The striped look you describe is typical of display systems that emulate the IBM PC color-graphics-display adapter. It comes from the 200-line vertical-resolution limit imposed by the TV-compatible scan rates combined with the noninterlace mode used to avoid jitter. This is a characteristic we learn to live with.

The high-quality character display you see on the IBM 5151 monitor is the result of using faster horizontal sweep and slower vertical sweep to give 350 or so lines of vertical resolution, combined with wider video bandwidth (frequency response) to provide 720-line horizontal resolution. The display board also has a different character-generator ROM to take advantage of the higher resolution.

If you try to use the 5151 monitor with your Tandy 1000 graphics display driver, you not only won't get an improved character display, you will also probably burn out the monitor's power supply due to the incompatible sweep rates.

It might be possible to put a display driver like the IBM monochrome display adapter into the Tandy 1000 and use the IBM 5151 or an equivalent monitor if you can find one that fits. The problem is that the Tandy's expansion slots are shorter than IBM's, so the IBM board won't fit. There may also be a memory conflict or other incompatibility that prevents use of both displays. This would be something to discuss with the Radio Shack people if you are interested.—Steve

CP/M and Graphics

Dear Steve,

Is it true CP/M can't manage any graphics, or am I imagining that? I recently added a Z80 Plus card to my Apple IIe so I could run Turbo Pascal. The Apple II, with its 6502 processor, is well known for its graphics capabilities, but Borland offers its Turbo Graphix Toolbox only for the IBM PC and Zenith Z-100 computers. Turbo Pascal itself comes with some turtle graphics but only for IBM PCs.

Is my Apple, running CP/M, able to make use of an RGB monitor for sophisticated graphics displays? If it can, why don't Borland and other companies implement these capabilities for us 8-bit CP/M users the way they do for 16-bit computers? I know that many owners of 8-bit machines running Turbo Pascal would love to have the sophisticated graphics offered to IBM owners. What's the problem?

Chad Gagnon
Crescent City, CA

There is nothing specific in CP/M that prohibits graphics. Historically, however, most of the computers using CP/M had no graphics hardware, and those that did had no standard to follow. Thus, in most cases, if you want graphics, you must write the drivers yourself.

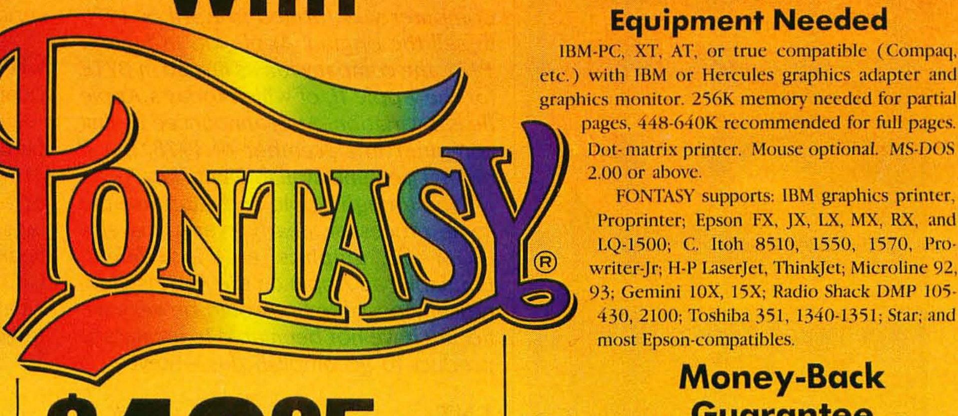
It seems as though one could use the Apple BIOS graphics routines with the CP/M board since the 6502 still handles I/O. I haven't tried this, but you could write drivers into CP/M to send the data and graphics commands to the 6502, at least for assembly-language programming.

The probable reason Borland, Microsoft, and other language vendors don't write graphics into their CP/M languages

(continued)

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Inquiry 284

is the lack of graphics hardware standards. If you write for a Motorola 6845 video controller, it won't run on machines using any other controller. You can, however, write subroutines or procedures in assembly language to be called by high-level-language programs if you can write the CP/M drivers to begin with.

Using an RGB monitor is possible in the Apple II only if you have an accessory board that provides that capability—hardware limitations again.—Steve

MYTHOLOGY

Dear Steve,

I see relatively few letters and articles pertaining to Atari computers in BYTE. I thus have been unable to find out more about the similarity between the Atari and the Apple, especially since it is well known that the original Apple was built out of an Atari. Has anyone repeated this feat? If so, where could I go to upgrade/emulate the Apple with my Atari 800XL?

SUE PAOLINI
Hoboken, NJ

Like many things that "everyone knows," this one just isn't true. Apple Computer was formed in April of 1976 to sell the original Apple kit. In June of 1977, the company ran its first ad in BYTE for the Apple II, of which today's Apple IIe is a variation. Atari announced its first computer in December of 1978, but it did not become available until late 1979.

Even though Apple and Atari use the same processor, nearly everything else (ROM, I/O, graphics, etc.) is different. Emulating an Apple on the Atari is theoretically possible but would be very difficult. I have not been able to locate any product to accomplish this.—Steve

TNT

Dear Steve,

I have a TNT, and I've tried a few times to interface it to my IBM PC. My PC has an internal Qubie modem with a serial port. I made a few attempts at building a connection, but whenever I ran a program in BASIC, I got the error message "device time out."

ITSHAK MIHAELI
Staten Island, NY

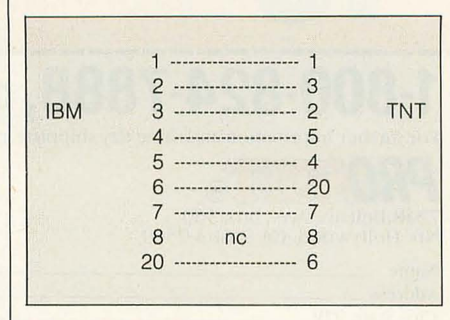


Figure 1: *The diagram for construction of a null-modem cable.*

There are several possible reasons for your troubles. First, be sure the serial port in the Qubie board is connected as COM1:. If it is COM2:, use the OPEN COM2: *statement in BASIC on the IBM side to open the serial port. Also, make sure both computers are set to the same data-transmission rate.*

Next, be sure you have connected the two computers as shown in figure 1. This arrangement is called a null modem.

If you are already using this arrangement and your cable has no bad connections, you should test each port with a loopback plug to find out which one is causing the problem. A loopback plug is a DB-25 (RS-232C) connector with the following pin pairs connected together: 2 to 3, 4 to 5, and 6 to 20. This plug makes the computer send data to itself and can be used to test each computer's serial port for proper function.—Steve

CHIPS

Dear Steve,

With the recent sharp price cuts in 256K-bit RAM chips, it seems that replacing the 4164s on the motherboard of an IBM PC or a Compaq would offer many advantages over an add-on memory board. I've heard that the 41256 chips can be substituted in some cases, but I don't know what sort of trace cuts or jumper settings might be required. Can you help?

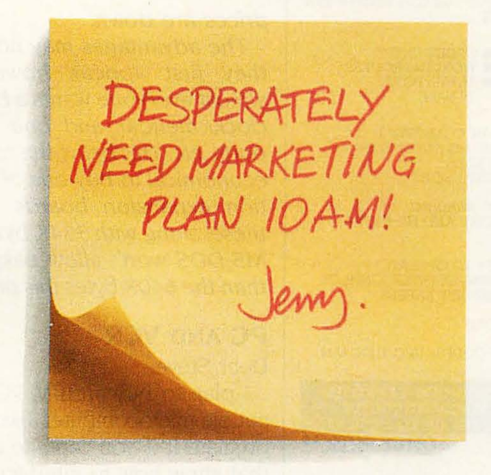
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Ballwin, MO

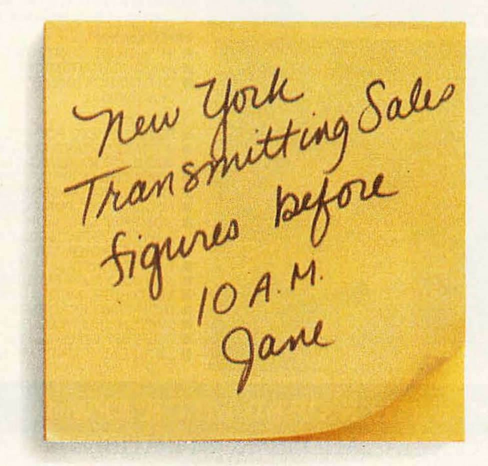
The 256K-bit 41256 chip pin-out is identical to the 4164, except for pin 1, which is NC on the 4164 and address A8 on the 41256. This allows 9-bit row address by 9-bit column address. The IBM PC has no provision for implementing the pin 1 address, and I don't think the Compaq does either.

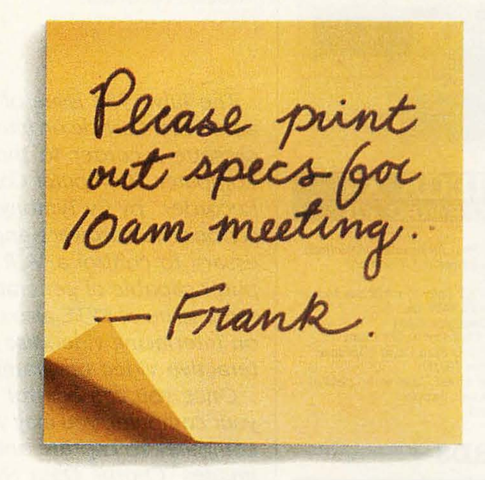
Changes on the board required to make this swap with jumpers would be extensive but probably not impossible. There were a couple of companies converting the early IBM 16K- to 64K-byte motherboards to use 64K-bit chips for 256K bytes total on the motherboard. Maybe someone will offer a similar service for the 256K-bit chips now that the

(continued)

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The advantages may not be as big as they first appear, however, because almost everyone wants a battery-backed clock/calendar and one or two serial ports, etc. This being the case, it is usually economical to buy one of the multifunction expansion boards that provides these, along with 384K bytes of memory. MS-DOS won't allow easy use of more than the 640K bytes this provides.—Steve

PC AND VCR

Dear Steve,

I plan to buy an IBM PC or a PC-compatible microcomputer. I would greatly appreciate it if you can cite any references that show how to interface it to a videocassette recorder.

P. L. K. SASTRY
Bombay, India

The July 1984 issue of BYTE contains an excellent article on interfacing a videocassette recorder to the TRS-80 Color Computer. "Computer Control of a Video Recorder" by Cy Tymony (page 179) describes the hardware and software necessary to control a VCR with any computer capable of generating sound. The same issue of BYTE also contains articles on interfacing videodisc players and interactive video programming.

Once you can control your VCR from your computer, you may want to use your computer to capture and modify video images. Chorus Data Systems (6 Continental Blvd., POB 370, Merrimack, NH 03054) sells hardware and software for the IBM PC that allows you to capture video data and save it in your PC. Photobase software from Chorus Data Systems lets you create a database containing both text and digitized video information.
—Steve

ATARI HOME CONTROL

Dear Steve,

How plausible is it to convert an Atari 2600 to a home controller, monitor, and security system? It seems to me that the 2600 has suitable graphics, I/O, and such to do so. Is it possible to do it through the ROM cartridge connector? Has anyone published specs and schematics for the machine? It seems that it would not be difficult, knowing the memory map, switches, and resident routines, to build a piece of hardware to use this machine. The firmware could be developed on another machine. I have in mind applications like laboratory monitoring, robotics, weather

(continued)

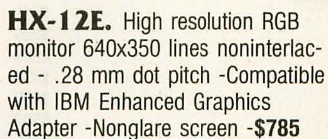
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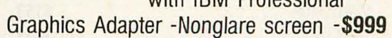


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I would buy your designs, but I am a medical student living on borrowed money, and the Atari 2600 is cheap.

SAM HUNTER
Galveston, TX

There are several good reasons not to use an Atari 2600 game machine as a home controller. The RAM and I/O capabilities are limited, and a second computer would have to be used for software development. Also, specs and schematics are available only to service centers; you may have a difficult time getting them.

Why not use an Atari 400 or 800? You can often find a used machine in good condition for as little as $25 that would provide a programming language and excellent I/O capabilities. Documentation, information, and finished products are readily available. You might want to refer to "Control Your Environment with the Atari 400/800" by David Alan Hayes (July 1983 BYTE, page 428).—Steve

SCIENTIFIC DATABASES

Dear Steve,

I would like to know where addresses of Canadian and American scientific databases are available. Technical databases in the field of graphic arts in connection with CAD, CAE, and CAM are especially important to me. Thanks.

CLAUS STERNBERG
Salzburg, Austria

The October 1984 issue of BYTE contains the article "Low-Cost On-Line Databases" (page 167). The author, Matthew Lesko, publishes a monthly newsletter that lists current free and low-cost databases. Contact Information USA, 4701 Willard Ave., Chevy Chase, MD 20815, (301) 657-1200.—Steve ■

IN ASK BYTE, *Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to*

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POB 582
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Due to the high volume of inquiries, personal replies cannot be given. All letters and photographs become the property of Steve Ciarcia and cannot be returned. Be sure to include "Ask BYTE" in the address.

The Ask BYTE staff includes manager Harv Weiner and researchers Larry Bregoli, Bill Curlew, Jeannette Dojan, Jon Elson, Roger James, Frank Kuechmann, Edward Nisley, Dick Sawyer, Andy Siska, and Robert Stek.

MICROSOFT LANGUAGES NEWSLETTER Vol. 1-3

News about the Microsoft Language Family

Structured programming in QuickBASIC—Part 1—Subroutines

The Microsoft® QuickBASIC Compiler provides powerful structured programming features that go far beyond BASICA's FOR/NEXT, WHILE/WEND, and GOSUB statements. True subroutines with scalar and array parameters are easy to use in QuickBASIC. All variables in subroutines are local unless they are declared as shared global variables in the current module, as shown below.

```
CALL MySort (howbig, Array())              'sort Array ()
        ...
SUB MySort (limit, Sieve (1)) STATIC       'Sieve is 1-dim
SHARED bubbles                             'global variable
        ...'MySort subprogram body
END SUB
```

QuickBASIC modular programming with separate compilation and subroutine libraries will be covered in Part 2.

Interlanguage calling support added to C, FORTRAN and Pascal

The current releases of Microsoft C, FORTRAN and Pascal have been enhanced to support interlanguage calling. This was accomplished by extending the language syntax in each language and by sharing the major components of the runtime libraries—program start-up, memory models, memory allocation and floating point math support. For example, in FORTRAN these extensions allow programs to call C functions with value parameters and variable length argument lists. Under XENIX,® the interlanguage calling support allows the standard XENIX C libraries to be accessed from Microsoft FORTRAN and Pascal.

Mixed model dynamic memory allocation in Microsoft C—Part 2

During program start-up in Microsoft C, any memory beyond the 64K limit of the default data segment is released to MS-DOS.® (The amount returned can be increased by using the /CPARMAXALLOC switch to LINK or the EXEMOD utility.) This allows C programs to "exec" child programs. The first call to the near heap allocation routine, *_nmalloc,* creates the near heap which can use the remaining free space in the default data segment. The first call to the far heap allocation routine *_fmalloc,* creates the first far heap segment by requesting a block of memory from DOS rounded up to the nearest 8K (power of 2 equal or larger than the global variable *_amblksiz*). Subsequent *_fmalloc* calls will expand the last far heap segment up to 64K before allocating another far heap segment. When all far memory has been used, *_fmalloc* will try to allocate the memory from the near heap.

Write to: Microsoft Languages Newsletter
10700 Northup Way, Box 97200
Bellevue, WA 98009 for product and update information.
Or phone:
(800) 426-9400. In Washington State and Alaska, call (206) 828-8088. In Canada, call (800) 387-6616.

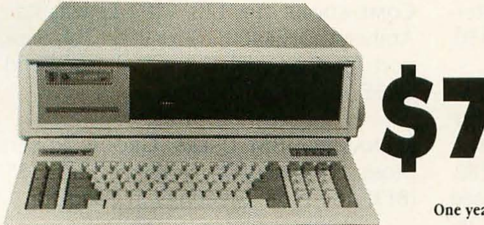
Latest DOS Versions:

Microsoft C	3.00
Microsoft COBOL	2.10
Microsoft FORTRAN	3.31
Microsoft Macro Assembler	4.00
Microsoft Pascal	3.31
Microsoft QuickBASIC	1.00

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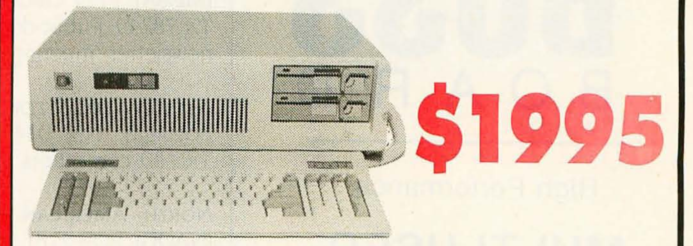
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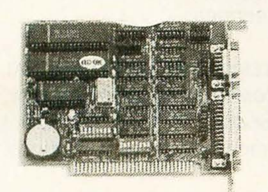
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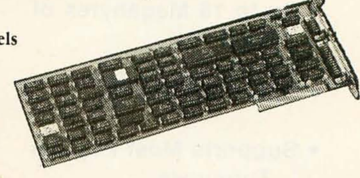
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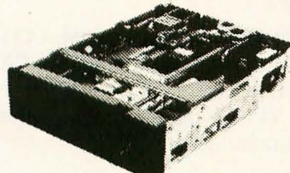
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THE KEPNER LETTER, 145 Grove St., Peterborough, NH 03458, (603) 924-9450. TRS-80 computers featured.

NORTH AMERICAN ONE-EIGHTY GROUP (NAOG), POB 2781, Warminster, PA 18974, (215) 443-9031. Users group for the SB180, Steve Ciarcia's single-board computer (see September 1985 BYTE). $15 per year includes 12 issues of newsletter.

SANYO USER GROUP OF THE SAN FRANCISCO BAY AREA, 1260 Westwood St., Redwood City, CA 94061, (415) 369-2034. Monthly newsletters and public-domain software library access. Annual fee: $20.

CASA MI AMIGA, c/o Kinetic Designs, 1187 Dunbar Court, Orange Park, FL 32073. 24-hour BBS for Amiga owners at (904) 733-4515. Public-domain software. Send SASE.

THE PILOT SIG, ADCIS International Headquarters, Miller Hall Room 409, Western Washington University, Bellingham, WA 98225. Only members of Association for the Development of Computer-Based Instructional Systems eligible. Meetings, newsletter, workshops.

STOUT MICROCOMPUTER USER GROUP (SMUG), John Wright, Tech Wing 248, University of Wisconsin—Stout, Menomonie, WI 54751. Student group, public-domain software library, meetings.

MICROPUBLISHING REPORT, 2004 Curtis Ave. #A, Redondo Beach, CA 90278, (213) 376-5724. Small computers in publishing. 12 issues: $175.

FREE BBS, Marshfield Technologies Inc., Data Processing Services Dept., POB 761, 171 South Central Ave., Marshfield, WI 54449. 1200-bps BBS at (715) 387-4028.

PANHANDLE COMPUTER SOCIETY, POB 30545, Amarillo, TX 79120-0545. Twelve SIGs, calendar, newsletter.

APPLE /// USERS OF NORTHERN CALIFORNIA (ATUNC), 220 Redwood Highway #184, Mill Valley, CA 94941. Meetings, newsletter. Annual subscription: $20.

COME-ADORE THE 128, 7102 Leavitt Rd., Amherst, OH 44001, (216) 986-6114. Support for C-64 and 128, newsletter. Send SASE.

MANASOTA IBM USERS' GROUP, Robert Moss, 111 Sunset Dr., Nokomis, FL 33555, (813) 484-1458. Meetings in Sarasota.

COMPUTER AIDED SELLING, The Denali Group, 1111 Third Ave., 7th Floor, Seattle, WA 98101, (206) 382-6668. News for salespeople. Annual subscription: $87.

THE CALGARY OSBORNE USERS GROUP, Greg King, 24 Edgedale Way NW, Calgary, Alberta T3A 2P8, Canada. Best for 8-bit CP/M users. Meetings.

SEATTLE CHAPTER OF THE INTERNATIONAL INTERACTIVE COMMUNICATIONS SOCIETY, POB 31273, Seattle, WA 98103, (206) 248-4968. Interactive video applications.

CONNECTICUT IBM PC USERS CLUB, John McGinley, POB 291, New Canaan, CT 06840-0291, (203) 762-0229. Meetings, newsletter, public-domain software.

SURVIVAL COMMUNICATION FORUM, 1435 Sebastopol Rd., Suite 210, Santa Rosa, CA 95407. 300- and 1200-bps, 24-hour, free BBS at (707) 545-0746. Resources for the survivalist community.

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SAMNA PIPELINE, SAMNA International User's Group, 1088 Bishop St., Suite 407, Honolulu, HI 96813. Monthly newsletter on using SAMNA. ■

CLUBS AND NEWSLETTERS *is an acknowledgment of new clubs and newsletters received at* BYTE. *Please allow at least four months for your club's mention to appear. Send information to* BYTE, *Clubs and Newsletters,* POB 372, *Hancock,* NH 03449.

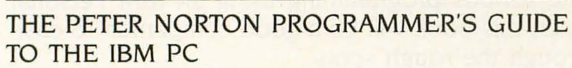
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THE PETER NORTON PROGRAMMER'S GUIDE TO THE IBM PC
Peter Norton
Microsoft Press
Bellevue, WA: 1985
426 pages, $19.95

THE COMPUTER CULTURE
Denis P. Donnelly, editor
Fairleigh Dickinson University Press
Cranbury, NJ: 1985
176 pages, $24.50

MICROSOFT MACINATIONS
Mitchell Waite, Robert Lafore, Ira Lansing
Microsoft Press
Bellevue, WA: 1985
497 pages, $19.95

THE COMPUTER LAW ANNUAL 1985
Miles R. Gilburne, Ronald L. Johnston, Allen R. Grogan, editors
Harcourt Brace Jovanovich
New York: 1985
405 pages, $60

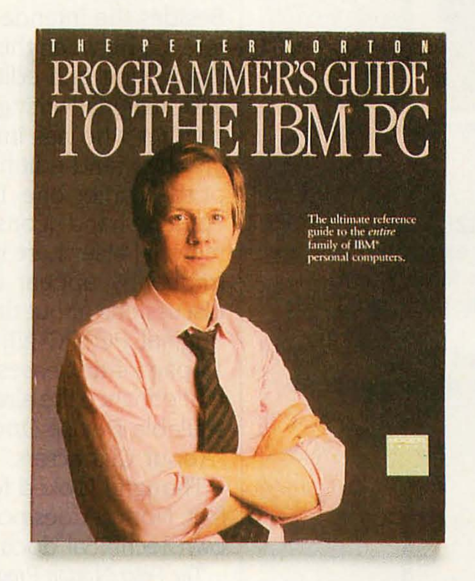


THE PETER NORTON PROGRAMMER'S GUIDE TO THE IBM PC

Reviewed by Donald Evan Crabb

Although the information Peter Norton provides in *The Peter Norton Programmer's Guide to the IBM PC* is not new or unique, reading it is an education. The book picks up where Norton's *Inside the IBM PC* (Robert J. Brady Co., 1983) left off. Whereas the earlier book concentrates on the hardware components of the IBM Personal Computer and how they work together, the new book is written strictly with the PC programmer in mind. Both works combined provide a comprehensive technical reference to the PC.

As you might expect, these books cover some material in common. For example, both explore the ROM BIOS of the PC. But the discussion in *The Programmer's Guide* is designed for the programmer. In fact, this book should be useful to anyone who needs to understand the technical details involved in creating PC programs. Norton makes the distinction right from the start that he is providing more than just PC programming knowledge. He is trying to impart concepts about PC programming.



Norton also concerns himself with the philosophy of programming the PC. He laces the book with explanations about the design concepts that permeate the entire IBM PC line. Due to Norton's wealth of experience working with PCs, this information is synthesized so that it is more useful than the usual dry engineering discussion that you often get in books of this kind. He carefully divides the ROM information into four chapters: ROM BIOS basics, ROM BIOS video services, ROM BIOS disk services, and ROM BIOS keyboard services.

The Programmer's Guide details the original PC. But keep in mind the subtitle of this book: "The ultimate reference guide to the *entire* family of IBM personal computers." Norton explains differences between the design, construction, and systems software of the other members of the PC family and the PC. Most of the examples and information describe the Intel 8088 microprocessor and how it's programmed through the services provided by the ROM BIOS and by DOS. Many of the programming examples use BASIC as the representative high-level language. Pascal and C-language examples also appear. Norton shows how to write 8088 assembly-language interface programs for each of these languages.

The scope of the book extends to a number of programming areas. From video and disk basics, Norton moves from how the keyboard operates in programs to all the programming aspects of DOS. The final two chapters, "Program Building" and "Programming Languages," are worth the price of admission alone. Norton covers the conceptual basics of writing, compiling and interpreting, linking, and executing programs. Especially informative are the discussions of the DOS LINK program and the logical organization of assembly-language programs.

Norton discusses both the IBM Pascal compiler and the generic Microsoft Pascal compiler. He discusses Pascal data formats on the PC and how to work with them, as

(continued)

well as integers, strings, SETs, and floating-point numbers.

A quote about compiler compatibility illustrates the book's usefulness: "For compatibility reasons, note that version 1 of the compiler has a floating-point format compatible with BASIC, and that version 2 has formats compatible with most other languages."

VISUAL EFFECTS

Besides the intended audience, the other noticeable difference between this book and *Inside the IBM PC* concerns the writing and editing. Norton has always had a good informational writing style, but *The Programmer's Guide* shows a writer who has improved at his craft. And the design, graphics, and editing of this book are superior to those of the earlier one. Illustrations are used to good effect. Pointing-hand icons are used to refer you to related material elsewhere in the book. Small logos and symbols frequently appear in a second color and differentiate discussions about the different members of the PC family: original PC, PC XT, PCjr, Portable PC, and PC AT. The 14-page index eases specific research. Three appendixes that enhance the already relevant material are entitled "Installable Device Drivers," "Hexadecimal Arithmetic," and "About Characters."

Though I looked for them, I couldn't find any errors of fact. Norton does point out some errors, however, in IBM's own technical documentation.

The Peter Norton Programmer's Guide deals primarily with the PC and the PC XT but also discusses some of the hardware and programming concerns of owners of the PCjr, the PC AT, and the IBM Portable PC.

I recommend this guide to PC programmers and to those people who need the technical information. While the prices of technically oriented softcovers have risen, the $19.95 price of Norton's guide is reasonable considering all the information that's packed into its 400-plus pages. Norton traces his selected territory well, providing helpful references to other PC publications. If you plan on some serious programming using an IBM Personal Computer, this book will be a good companion to ease you through the rough spots.

Donald Evan Crabb is director of instruction and laboratories at the University of Chicago (Department of Computer Science, Ryerson Hall 163, 1100 East 58th St., Chicago, IL 60637). He is on the review board of InfoWorld.

THE COMPUTER CULTURE

Reviewed by Hugh Kenner

The six talks in this book were delivered by six speakers at a symposium that Siena College staged in 1981, and aging for five years has not improved them. University presses have a natural abhorrence of symposia—some won't consider symposium proceedings at all—and once

(continued)

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Some pages in The Computer Culture, *like the ones covering on-line conferencing, are so archaic they give off an odor of lavender.*

they do decide to move, their production speed can be an order of magnitude slower than the computer culture requires. I'm willing to guess that someone at Fairleigh Dickinson University Press saw "social issues" seeming to be addressed and finally gave a green light on the principle that social issues evolve less quickly than hardware.

The symposium was "part of Siena College's integrated humanities program" (translation: nothing too technical here), and the editor, Denis P. Donnelly, dithers mightily to persuade us that the jargon of social science, of which he is far from being a native speaker, can confer humane generality on something as rinky-dink as "the transistor switch."

Here's a sample: "When changes effect quantitative displacements, they also become agents of qualitative change in a given environment whether one is logging in a forest or waging war on a battlefield, for example." If prose, like Pascal, required writers to declare their variables, a sentence like that would detonate error messages. What it's trying to say is probably something like, "The transistor by its sheer speed has changed everything; so grab your hat and read on."

Like most of the introductory matter, what it's also saying is, "These big themes require big ponderous sentences. We address major issues here. The world we all grew up in slips from our grasp. Accredited themes for worry are well known: big machines, big changes, Big Brother. We'll all be worrying along."

Let me get most of this out of the way quickly. Some pages, like the ones covering a discussion of on-line conferencing, are so archaic they give off an odor of lavender. Elsewhere familiar worries are reinforced. While the computer can model fearfully complex interrelationships, we must beware of assumptions that get built into the model; "We are never free from the potential for misuse." That is something we'd all heard before we came in. Likewise, "We need computer systems and the information they produce, but somehow their limitations must be recognized." Somehow! You could glean as much from any op-ed page.

The first half of the book is about "Artificial Intelligence," the second half about "Computer Influences in Modern Culture." The former is unexpectedly rich; I'll come to it. The latter does contain one chunk of meat: Alan F. Westin's discussion of privacy, technology, and regulation.

The market, Westin reminds us, "deserves our continued respect" because "much of what could be done by com-

(continued)

puters will be done on a large scale in the United States only if someone can make a great deal of money from it or if the government is willing to pay for it." Most of the Big Brother talk we've heard implies "awesomely expensive" implementation, and "Information is a power resource that nobody gives freely."

In fact, "We can. . .often give greater protection to information in a computer system than in the highly decentralized, leaky manual-record era." No, Westin's *not* sanguine, but "as long as we keep on struggling, pointing out the potential abuses. . .we will not be caught unaware." He discerns "an interesting marriage between the liberal political and the strong conservative viewpoints on limiting information abuse," and he's right.

That is one rewarding stretch in this book, and the other is the AI section. MIT's Marvin Minsky and Yale's Roger C. Schank set up a discussion that never gets off the ground because on page 79, "Influences in Modern Culture" drearily takes over. I don't downplay Minsky if I call Schank especially interesting. Minsky's format didn't allow him to canvass particulars the way Schank's did, and Schank gives as lucid an account of his script-recognition work as you'll find anywhere.

How does a program work its way through a story so effectively it can answer questions the story leaves implicit? By translating downward into a more general language with, for instance, just 11 "verbs." "Eleven primitive actions can express *all* human activities that there are in the world." A fascinating claim, and we're shown the list.

Schank is saying that if we stay inside a system of words we can hope to generate whatever additional words may be required to pass Turing's test. (Turing's test implied that a machine might as well be called "intelligent" if a questioner couldn't tell it wasn't.) In a "Postscript" the Siena audience apparently never heard, Skidmore's Warren Hockenos denies that radically. You cannot, he implies, reduce "meaning" by altering strings of tokens to other strings of tokens; "meaning" implies an intending intelligence. When I say "horse" I assert my perception of a horse, "real" perhaps or hallucinatory perhaps, but somehow perceived, by me, and that matters.

How it matters we might have learned if Schank had answered, but as far as I can tell they never heard each other. That's the major botched opportunity in a botched book.

Hugh Kenner is a professor of English at Johns Hopkins University (Baltimore, MD 21218).

MICROSOFT MACINATIONS
Reviewed by Scott L. Norman

Microsoft Macinations is an excellent self-teaching guide to Microsoft BASIC as implemented on the Macintosh. Mitchell Waite, Robert Lafore, and Ira Lansing have

(continued)

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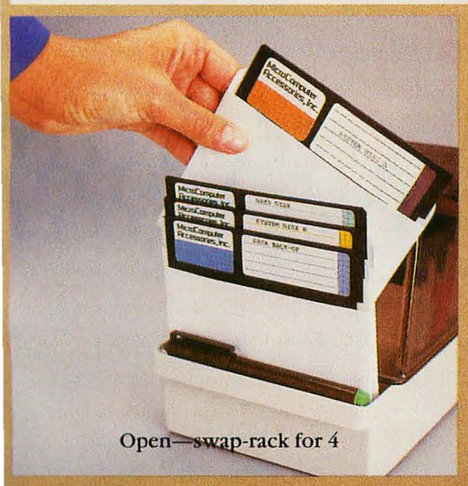
Mystery solved, Watson. This new 50 + 4 Locking Disk File provides a locking, smoked plastic enclosure for up to 50 5¼″ diskettes, *plus* an open, up-front, instant access, swap-rack for 4 diskettes. Let me call your attention to the built-in handle, and the adjustable dividers with adhesive labels. Note the rear storage pocket for extra labels.

By Jove, Holmes, open and shut simultaneously! It's perfect for those powerful integrated, multi-disks systems—and no one's thought of it before! Holmes, you never cease to amaze me.

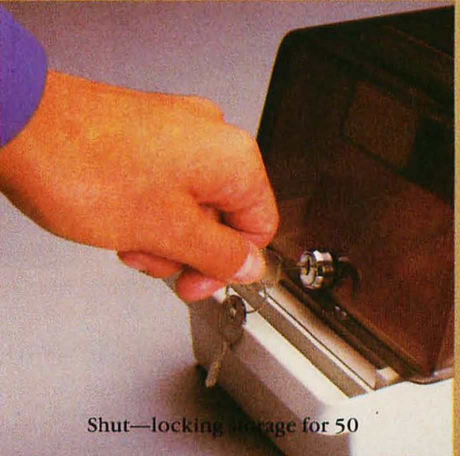
Elementary, my dear Watson.

MicroComputer Accessories, Inc.

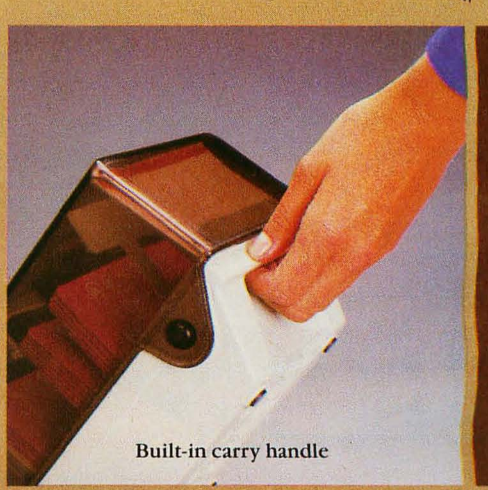




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The authors use a simple program fragment to introduce a major topic, then build upon it by describing how to add more polished options.

the reader with code that can be used to add menus to BASIC programs. Like the commercial variety, user-written menus can include such niceties as check marks to indicate the last selection made and dimmed lettering for selections that are unavailable at a particular point.

The step-by-step approach is characteristic of this part of the book. The authors use a simple program fragment to introduce a major topic, then build upon it by describing how to add more polished options. The attentive reader can wind up with the beginnings of a nice library of core routines for civilized programming.

The book then covers video "buttons" activated with a mouse click. There are three types: push buttons, which make things happen immediately, and radio buttons and check boxes, both of which can be used to make selections that will influence some subsequent action. The DIALOG function is introduced as the means of determining which button, if any, has been "clicked."

Windows, dialog boxes, and edit fields (like the filename box in the "Save As. . ." window) are covered at length. The versatile DIALOG gets a major workout here. The reader can learn how to set up dialog boxes that will accept either the clicking of a "Save" button or the pressing of the Enter key on the Mac's keyboard to record data in an edit field: another example of using built-in routines to add polish to your own code.

QUICKDRAW

The most publicized of the Mac's ROM resources is probably the QuickDraw family of graphics routines, reached from BASIC with a CALL statement. The authors contrast QuickDraw with LINE, CIRCLE, and similar functions of other Microsoft BASICs.

The concept of QuickDraw's pen metaphor for drawing leads to other topics: functions for drawing lines and changing the size and pattern of the pen itself. This in turn brings up the idea of representing an 8 by 8 arrangement of pixels (the pen pattern) as an array of hexadecimal numbers for storage in the Mac's memory. There is even a BASIC program, Pattern Editor, with which you can create a pattern in a FatBits-like window; the program then generates the associated integers. In one of the book's few miscues, the backslash symbol for integer division is used in this program without ever being defined in the text.

The final topics in the chapter include the PENMODE

(continued)

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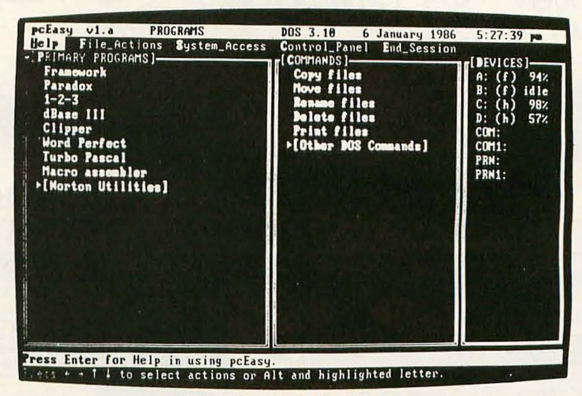
STANDARD DOS SCREEN

pcEasy v1.a RESIDENT SELECT DOS 3.10 Mon 6 Jan 1986 5:40:56 pm
Create Files View Control Notes Options Utilities Quit
Press F1 for Help. Select a file to use.
pcEasy Path: C: DOCUMENT

pcEasy file name	Category	Size	Date	Time	Short name
Basic software license	Datafile	9,725	8/13/85	5:23p	LICENSE .DOC
Custom UNlock Information	Datafile	1,044	10/04/85	9:58a	CUSTOM .TXT
Dealer and Distributer Sheet	Datafile	2,678	10/31/85	10:18a	DEALER_&.TXT
Dealer information sheet	Datafile	2,303	7/19/85	10:22a	DLRINFO .TXT
Equipment lease change	Datafile	1,558	11/18/85	11:58a	LEASEADD.DOC
Fox & Geller Quickcode Data	Datafile	1,048	7/02/85	5:08p	F&G_QC_I.TXT
Letter to Byte Magazine	Datafile	1,554	12/06/85	6:48p	BYTE .LTR
Letter to J. Pournelle	Datafile	2,019	10/25/85	5:53p	POURNELL.DOC
Letter to PC Week	Datafile	2,648	7/09/85	5:08p	PC_WEEK_.TXT
Managing Your Money Data	Datafile	260	7/02/85	5:08p	MANAGING.TXT
Software license with IGI	Datafile	9,725	8/13/85	5:38p	LICENSE .IGI
Stockholder Letter, Sept. 85	Datafile	12,141	9/17/85	3:24p	STHLD091.
UNlock Album B information	Datafile	3,719	12/16/85	3:34p	ALBUMB .ADM
UNlock User Instruction Card	Datafile	3,073	7/16/85	3:33p	USER_INS.TXT
UNlock User Manual	Datafile	20,272	7/02/85	6:02p	UNLOCK_U.TXT
UNlock User Registration Card	Datafile	1,558	11/01/85	5:12p	REGISTER.CRD
	TOTAL	368,038			

Path: C:\DOCUMENT\

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Anyone mastering all this material could possbily write a BASIC version of MacPaint.

statement and the ways in which its eight modes affect the relationship between the pixels of the pen and pattern and the background, and the use of QuickDraw's built-in routines for drawing rectangles, round-corner rectangles, and ovals. Anyone mastering all this material could possibly write a BASIC version of MacPaint as a final exercise.

Microsoft Macinations returns to more conventional topics with a discussion of sequential and random-access disk files. First, the reader is gently led through the commands for opening, closing, writing to, and reading from a sequential file. Next come the useful Mac-specific functions FILES$(0) and FILES$(1). The former sets up a dialog box for saving a file, complete with prompting message and push buttons. FILES$(1), on the other hand, allows you to select the name of an existing disk file from a scrolling dialog box. There is a brief discussion of file-type identifiers and their use in restricting the names that appear in the box.

The coverage of sequential files ends with a little program that creates a simple employee file and calculates total pay from pay rate and hours worked. The same topic is used as an example in the discussion of random-access files. This portion of the book includes a nice treatment of the necessary conversion of numeric variables to character strings before they can be written to a random-access file. The use of index tables for finding your way around a file is touched upon; no sample programs are developed, however.

The last two chapters cover animation and multivoice sound—possibly as rewards for mastering the material on files. The GET and PUT statements, which together with PSET and PRESET form the basics of animation, are introduced. The authors present a convenient form of the equation for computing the size of the one-dimensional array needed to store image points. They also explain the use of a two-dimensional array for storing multiple images for animation. The final topic in the animation chapter is interfacing with MacPaint—that is, importing images through the Clipboard. That is as close as the book comes to discussing the Mac's generalized device I/O.

Multivoice sound depends on two commands: SOUND and WAVE. The final chapter of *Microsoft Macinations* deals with them. Here you can find the details of how to set up a data array to simulate the equal-tempered scale. There are numerous routines for adding sound effects to games, programming music chords, and experimenting with nonsinusoidal waveforms. The last program is a rather elaborate waveform tester that allows you to experiment

(continued)

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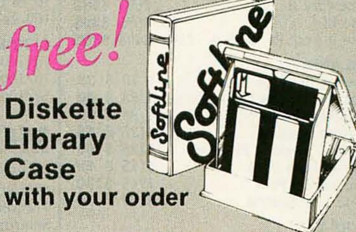
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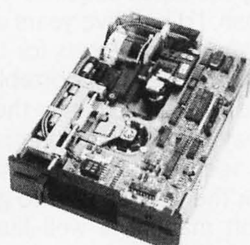
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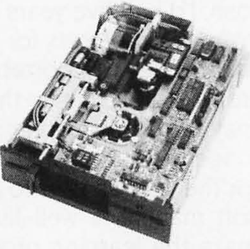
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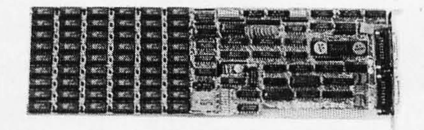
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with changing the shapes of the waves in two different voices. You can choose from sine, square, or sawtooth waveforms, or you can design your own by drawing with the mouse. The whole thing is also a good review of BASIC's menu and button commands.

LASTING IMPRESSIONS

By the time I acquired Microsoft BASIC for my own Macintosh, I'd had five years of experience with the same company's interpreters for the Radio Shack Color Computer and Model 100 portable. As a result, I anticipated little trouble in picking up the details of the new package. That may have been optimistic; the process seemed to take longer than it should have. While I still think it possible for the veteran user to get by with nothing but the Microsoft manual, a well-illustrated and less terse book can make the learning process a lot easier.

Microsoft Macinations is one of the best such books. It is well paced (with the exception of the very early pages), and it is written in a style that avoids Mac-cutesiness. The book's emphasis on special features of the user interface, combined with the useful program components, leads me to believe that I will be referring to my copy for some time to come.

Scott L. Norman (8 Doris Rd., Framingham, MA 01701) is a frequent contributor to computer magazines.

THE COMPUTER LAW ANNUAL 1985

Reviewed by David A. Price

Few industries have created as many difficult legal issues in as short a time as the computer industry. Although some lawyers have developed specialized expertise in "computer law," as it is now called, the industry is far too large and the issues too pervasive to be left to specialists. Miles R. Gilburne, Ronald L. Johnston, and Allen R. Grogan, the editors of *The Computer Law Annual 1985*, have performed a valuable service by assembling an excellent group of articles about the legal problems that computer businesses often face.

Its 20 articles are from a legal journal, *The Computer Lawyer*. They cover a wide variety of issues, most of them pertinent to computer businesses of all sizes. Not surprisingly, the topic receiving the most coverage is that of protecting proprietary rights to software. Instead of giving only a recitation of the legal doctrines governing copyright and trade-secret protection, the articles go further by tackling some difficult questions. To what extent can a firm permissibly "reverse-engineer" a copyrighted software product by disassembling it? When should a firm require a license agreement for the sale of software and when should it just rely on copyright? When does a programmer own the copyright to a software product that he or she wrote as an employee? How can a firm enlist the help

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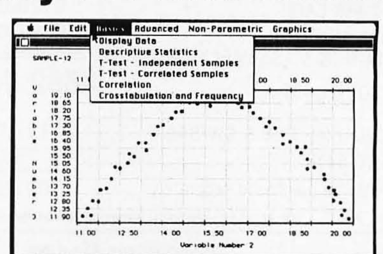
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of the U.S. Customs Service to prevent the importation of an infringing product?

The book also discusses such diverse topics as avoiding antitrust liability, drafting warranties, securing access to a vendor's proprietary information in case the vendor becomes bankrupt, obtaining start-up capital, compensating employees, and reducing taxes. Because the annual is intended for practicing lawyers, its emphasis is on solving real problems rather than on academic theorizing. To help a lawyer investigate a question further, the book gives citations where appropriate to legal references such as case reporters, which contain the published decisions of courts; the U.S. Code, which contains federal statutory law; and the Code of Federal Regulations, which contains the regulations issued by federal agencies.

The contributors display an unusual command of the technical aspects of the field. For example, in two articles that examine copyright issues in writing a BIOS compatible with the IBM Personal Computer, the contributors freely discuss the use of software interrupts—a topic beyond the grasp of most lawyers and more than a few programmers. That level of technical understanding is necessary, however, for an intelligent analysis of the question involved. To avoid infringing IBM's copyright, is it enough simply to avoid copying exact sequences of IBM's code? Must you also avoid copying IBM's algorithms, which happen to be available from a source listing in an IBM manual? Must you avoid copying IBM's device-dependent timing loops? Can IBM claim protection for its interrupt scheme?

Despite its astute handling of technical matters, the book maintains its focus primarily on lawyers. Nonlawyers would have difficulty following some of the articles; unexplained legal terms appear throughout. An article about contract negotiation, for instance, refers to "liquidated damages" and "choice of law and forum provisions" with the assumption that these phrases need no explanation.

One slightly disappointing aspect is that the contributors rarely make arguments about policy. They describe the directions in which the legal rules are forming, but they say little about what kinds of rules are desirable. One of the articles about antitrust is a refreshing exception. After showing how the operation of the Robinson-Patman Act frequently thwarts its own stated purpose of increasing competition, the article concludes that the Act "is difficult to defend." Equally blunt arguments about other areas of computer law would be enlightening.

This omission is understandable, however, because the purpose of the book is to inform rather than persuade. For lawyers who have computer firms as clients, and for managers who are willing to wade through some legal jargon, *The Computer Law Annual 1985* is first-rate. It discusses the nuts and bolts of computer law with precision and authority. ■

David A. Price (57 Roseland St. #2, Somerville, MA 02143) is a third-year law student at Harvard University.

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SEVENTH ANNUAL COMPUTER GRAPHICS CONFERENCE: EMERGING FROM THE CHAOS, Hollywood, FL. Carol Every, Frost & Sullivan Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080. *March* 5–7

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1986 EASTERN SIMULATION CONFERENCES, Norfolk, VA. The Society for Computer Simulation, POB 17900, San Diego, CA 92117-7900, (619) 277-3888. *March* 10–12

CIMTECH '86, Boston, MA. Cheri Willetts, Society of Manufacturing Engineers, One SME Drive, POB 930, Dearborn, MI 48121, (313) 271-1500, ext. 374. *March* 10–13

FOURTH ANNUAL TECHNOLOGY IN TRAINING AND EDUCATION CONFERENCE (1986 TITE), Montgomery, AL. Thomas S. Allman, HQ AU/XPZ, Maxwell AFB, AL 36112, (205) 293-6160. *March* 10–13

ETHICS AND EXCELLENCE IN COMPUTER EDUCATION: CHOICE OR MANDATE, Tempe, AZ. Gary Bitter, College of Education, Payne 216, Arizona State University, Tempe, AZ 85287, (602) 965-7363. *March* 12–14

HANNOVER FAIRE: CEBIT '86, Hannover Fairgrounds, West Germany. Hannover Fairs USA Inc., POB 7066, 103 Carnegie Center, Princeton, NJ 08540, (609) 987-1202. *March* 12–19

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NUMERICAL METHODS AND DIGITAL COMPUTER TECHNIQUES FOR ENGINEERS AND SCIENTISTS, Los Angeles, CA. Short Course Program Office, UCLA Extension, 10995 Le Conte Ave., Los Angeles, CA 90024, (213) 825-1295. *March* 17–21

1986 IEEE VLSI TEST WORKSHOP—MICROSYSTEM: NEW TEST CHALLENGES, Atlantic City, NJ. Wesley C. Radcliffe, IBM Corp., East Fishkill Facility, Dept. 277, Building 321-5E1, Hopewell Junction, NY 12533. *March* 18–19

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SOUTHCON/86, Orlando, FL. Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045. *March* 18–20

PERSONAL COMPUTER INTERFACING FOR SCIENTIFIC INSTRUMENT AUTOMATION, Blacksburg, VA. Dr. Linda Leffel, C.E.C., Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, (703) 961-4848. *March* 19–21

THIRD ANNUAL PHYSICIANS AND COMPUTERS: APPLICATIONS IN PATIENT CARE, Las Vegas, NV. Beverly J. Johnson, University of Southern California School of Medicine, Postgraduate Division, 2025 Zonal Ave., KAM 318, Los Angeles, CA 90033, (213) 224-7051. *March* 19–23

WESTERN EDUCATIONAL COMPUTING WORKSHOPS, Orange Coast College, Costa Mesa, CA. Alexia Devlin, California Educational Computing Consortium, San Francisco State University, Accounting Data, NADM-358, 1600 Holloway Ave., San Francisco, CA 94132. *March* 21–22

OAC '86—INTEGRATED SYSTEMS: MERGING ISLANDS OF TECHNOLOGY, Houston, TX. OAC '86, American Federation of Information Processing Societies Inc., 1899 Preston White Drive, Reston, VA 22091, (800) 622-1986. *March* 24–26

ARTIFICIAL INTELLIGENCE '86 CONFERENCE, Singapore. John Tagler, Elsevier Science Publishers, 52 Vanderbilt Ave., New York, NY 10017. *March* 24–27

COMTEL '86, Dallas, TX. International Conference Management Inc., 15851 Dallas Parkway, Suite 1155, Dallas, TX 75248, (214) 458-7011. *March* 24–27

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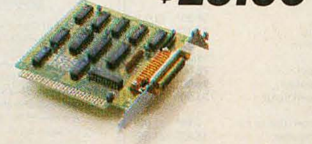


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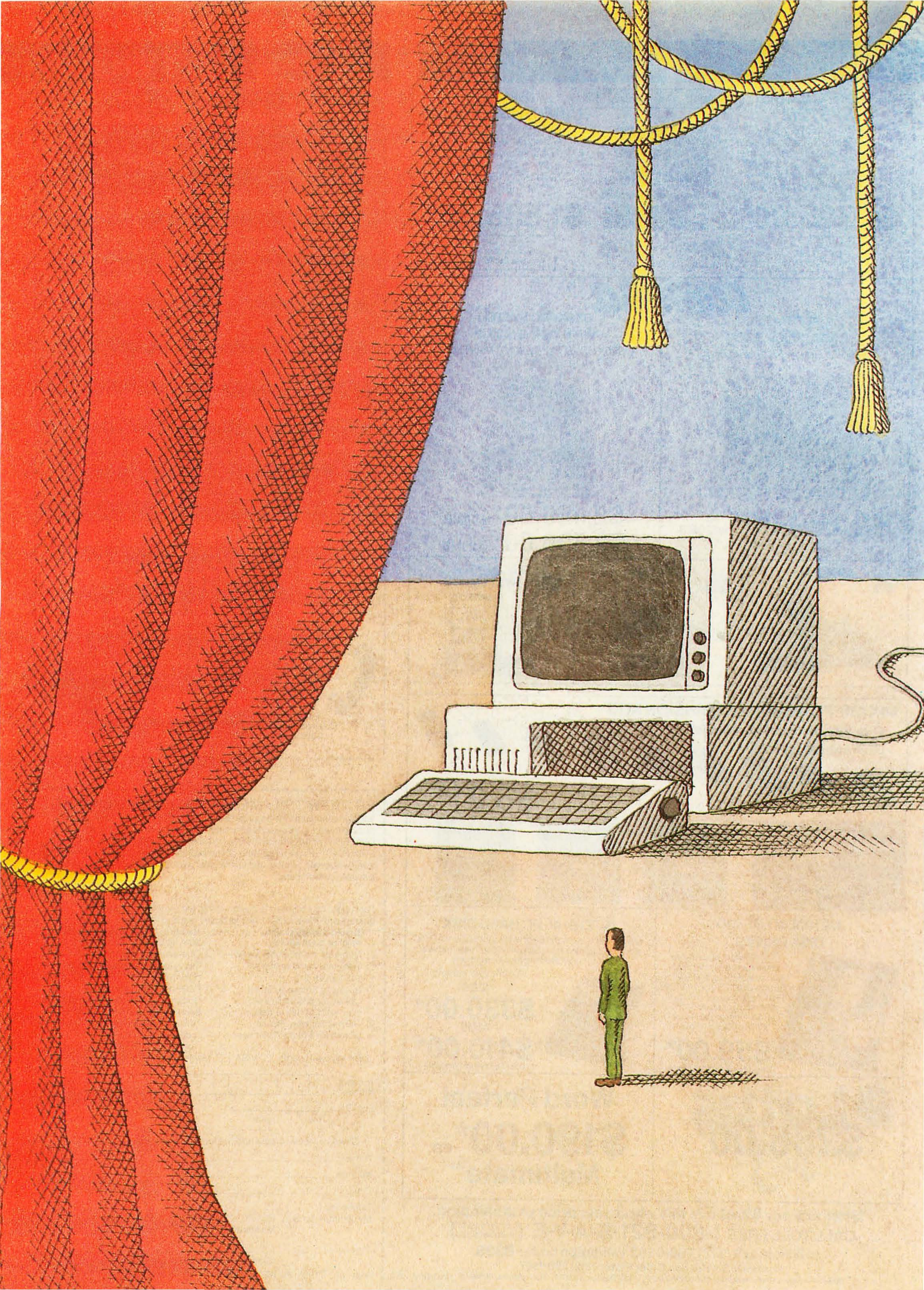
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Features

THIS MONTH, BYTE PRESENTS a preview of Atari's new $999 1-megabyte machine—the 1040ST. Although the system is similar to Atari's 520ST, it has twice the memory capability, an internal double-sided disk drive, an empty socket for a graphics coprocessor, and it is the first computer to begin its retail life at a cost of less than one dollar per kilobyte. The article also includes an interview with Shiraz Shivji, Atari's vice president of research and development, who discusses the company's plans for the future.

In "Finding the Titanic," Marti Spalding and Ben Dawson take a look at the state-of-the-art image-processing equipment used in the underwater exploration that located the sunken *Titanic*. The ship was lost in the Atlantic for 73 years until teams of French and American researchers, with millions of dollars worth of equipment, were able to pinpoint the wreck.

In Ciarcia's Circuit Cellar, Steve offers us a choice of real-time clocks. The first one uses a CMOS chip that you attach to the computer through parallel ports. This conventional approach appeals to those who want a quick resolution of a problem. The second clock uses a unique concept that Steve believes will prevail long into the future. It uses a new clock "socket" that requires no independent interfacing and merely plugs in with a static-RAM chip.

The Programming Project is the first of a two-part article by Bruce Webster. Bruce mentions that windowing systems can be and have been implemented on most of the more "mundane" computers. The goal of his article is to show you how to do this. In Part 1, Bruce covers basic principles and examines the problems involved in opening a window.

As C has become more popular among developers and programmers, it has become necessary to establish a standard to keep C programmers working with the same language. "An ANSI Standard for the C Language," by Steve A. Hersee and Dan Knopoff, describes the standard that has been proposed by the ANSI Standardization Committee and invites participation in establishing the standard.

This month's Programming Insight describes a disassembler program. In "Macintosh Explorer," Olav Andrade explains that when using a Macintosh he discovered that the Toolbox/Operating System routines would be vital to his applications. His problem was that he needed to know how the Toolbox calls were made and Macintosh Explorer was his solution. It is written in Microsoft BASIC for the Macintosh.

THE ATARI 1040ST

A *megabyte of memory for* $999

Editor's note: The following is a BYTE *product preview. It is not a review. We provide an advance look at this product because we feel that it is significant. A complete review will follow in a subsequent issue.*

Atari's new $999 1-megabyte 1040ST (see photo 1) establishes a price break reminiscent of the Commodore 64's. And, as table 1 shows, the 1040ST will be the first computer to begin its retail life at a price that represents less than one dollar per kilobyte. The 1040ST is clearly a bargain, with over 1 megabyte of RAM (random-access read/write memory), its operating system in ROM (read-only memory), an internal 720K-byte double-sided drive, an internal power supply, and the same features and functionality that already make the Atari 520ST an attractive purchase. [*Editor's note: See "The Atari* 520ST" *by Jon R. Edwards, Phillip Robinson, and Brenda McLaughlin, January* BYTE, *page* 84.]

SYSTEM DESCRIPTION

Our coverage of the 520ST adequately describes most of the features of the 1040ST (see also the "In Brief" box on page 86). The new computer has the same keyboard, the same ports (although these are now in new locations, see photo 2), and the same architecture. We remain uncomfortable with the keyboard, but the keytops are removable. We suspect that some speedy entrepreneur will provide alternative tapered keys for the ST machines.

The most obvious changes are cosmetic: The keyboard/computer unit is 2 inches deeper and 4½ pounds heavier than the 520ST, and the keyboard provides a much more substantial feel. The mouse/joystick ports are now located under the bottom right front of the unit, a significant improvement for left-handed users.

A number of changes are more than cosmetic. The internal power supply eliminates two of the external power supplies needed by the 520ST (wire haters rejoice). We left the unit on for five days and experienced no difficulties with overheating. There is no internal fan, but the unit appears to adequately dissipate heat. The internal disk drive supports both single- and double-sided disks. An RF (radio frequency) modulator will allow you to hook up the 1040ST to a television set; you might, therefore, obtain the high-resolution monochrome system for word processing and programming without sacrificing the use of low- and medium-resolution color. However, we received a preproduction unit lacking the RF modulator that will accompany the final product; therefore, we were unable to test the television quality of the computer's output.

The megabyte of RAM in the 1040ST isn't crammed into the case. The 520ST uses a custom Memory Controller chip to handle its sixteen 256K-byte dynamic RAM chips. The 1040ST uses the same Memory Controller. Because the controller can handle 32 RAM chips at a time, the Atari engineers simply had to find room for 16 more 256K-byte dynamic RAMs on the 1040ST circuit board to pump RAM capacity to a full megabyte (see photo 3). In fact, the Memory Controller can also govern 1-megabit dynamic RAM chips. Atari should have little difficulty designing an ST with 4 megabytes of memory.

Undoubtedly, the most interesting addition to this computer, apart from the extra memory, will be an empty socket for a graphics coprocessor. Our preproduction unit also did not include the socket, and it may not be offered with the first releases of the 1040ST. Phil Robinson discussed this and Atari's future plans with Shiraz Shivji, vice president of research and development for the company (see the text box "An Interview with Shiraz Shivji" on page 90).

TOS IN ROM

With TOS (the operating system for both the 520ST and the 1040ST) in ROM, the 1040ST boots more quickly than the 520ST. [*Editor's note: Atari is currently supplying the* ROM *chips to* 520ST *developers and will be making the chips available through users groups.*] Booting with a nonsystem disk takes less than 6 seconds, down from 37

(continued)

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BY PHILLIP ROBINSON AND JON R. EDWARDS



Photo 1: *The Atari* 1040ST.

PHOTOGRAPHED BY PAUL AVIS

IN BRIEF

Name
Atari 1040ST

Company
Atari Corp.
1196 Borregas Ave.
Sunnyvale, CA 94086
(408) 745-2000

Price
With monochrome monitor, $999
With color monitor, $1199

Microprocessor
Motorola 68000, a 32-/16-bit microprocessor (32-bit internal architecture with 24-bit, nonsegmented, external data bus) running at 8 MHz

Main Memory
1024K bytes of dynamic RAM

ROM
192K-byte TOS in ROM, not including the desktop accessories

Graphics
Three modes: 640- by 400-pixel monochrome, 320 by 200 with 16 colors, and 640 by 200 with 4 colors

Sound
Three independent sound channels from 30 Hz to 125 kHz

Floppy-Disk Drive
Internal 3½-inch double-sided double-density drive with capacity of 720K bytes. System supports maximum of two floppy-disk drives.

Keyboard
94-key Selectric-style QWERTY keyboard with numeric keypad, cursor controls, and rhomboid function keys

Interfaces
MIDI in and MIDI out ports
Monitor port (supports RGB analog, high-resolution monochrome)
RF modulator
Centronics parallel printer port (supports Epson-compatible printers)
RS-232C serial port
Floppy-disk port
Hard-disk port (10-megabit-per-second DMA transfer rate)
128K-byte ROM cartridge port
Ports for mouse or two joysticks

Bundled Software
Atari Logo
ST BASIC

Optional Peripherals
SF354 single-sided drive
SF314 double-sided drive

Planned Expansion
Graphics coprocessor, SMM801 dot-matrix printer, SDM121 daisy-wheel printer, 10-megabyte fixed disk, 8-slot expansion interface, CD-ROM, local-area network for MIDI port

seconds on the 520ST. After booting, the color system displays blue and yellow crossbars instead of the multicolor display shown on the 520ST. The desktop icon also appears in much brighter green on the 1040ST, which Neil Harris of Atari explains is more effective on color television screens for those who will make use of the RF modulator.

Although it increases the time to 17 seconds, you may prefer to boot with a nonsystem disk that includes the desktop accessories. By so doing, you can maintain access to the Control Panel (to change the background color, for example), the RS-232 Port Configuration, and the Install Printer facilities. You also have the option of placing the operating system (38 seconds), and presumably any alternative operating system, into RAM.

The ROM TOS appears to be functionally identical to the first release of TOS in RAM, but there have been some additions. In the interest of supporting business applications, the ROM TOS raises the limit on open files from 30 to 100. A new dialog box informs you if you have insufficient memory to run an application. The earlier versions of TOS simply return you to the desktop. Two new GEM functions, form_button and form_keyboard, will allow developers to bring up dialog boxes without freezing the current application. You could, for example, postpone your response until you finish a task.

Most of the other changes involved crunching the code from over 200K bytes to 192K bytes (Landon Dyer, software design engineer for Atari, reports that the production ROMs are a mere 14 bytes short of 192K bytes), but there have also been a number of modifications and corrections, many in response to the experiences of ST developers. Early versions of TOS did not allow you to print from the desktop if you set your printer to the serial port. Now you can. Full type-ahead buffers will no longer eat characters. And icon grabbers can take comfort in the fact that rapid movements of icons into the

menu bar can no longer crash the system.

A SAMPLE SESSION

We obtained similar results on BYTE's standard benchmark tests for both the 520ST and the 1040ST. Using ST BASIC (see photo 4), both machines ran the Sieve of Eratosthenes in 85 seconds and the Calculations benchmark of 10,000 multiplication and 10,000 division operations in 32 seconds. Both formatted single-sided disks (357,376 available bytes) in 54 seconds. The 1040ST took 102 seconds to format a double-sided disk (726,016 available bytes). It took 16 seconds with the 520ST to transfer a 40K-byte file from one single-sided drive to another. It took 17 seconds to transfer the same file from the 1040ST's internal drive to an external single-sided drive.

In conducting the tests, we had two small problems. First, when we connected an external single-sided drive and took a directory of the internal drive, the 1040ST appeared to poll both drives. We got the directory we requested, but the fact that the internal drive is so quiet made it seem that we had inadvertently addressed the external drive. The whirring of the external drive was a continual annoyance.

Second, Atari's ST BASIC reserves approximately 160K bytes to buffer graphics, store arrays, and so on. On the 1040ST, with TOS in ROM and when booting with the desk accessories, you still obtain a workspace in excess of 700K bytes. On the 520ST, with TOS in RAM, we obtained a workspace of only 5K bytes. To run the Sieve, which dimensions an array to 7000 elements, we had to boot without the desk accessories (a savings of about 30K bytes), eliminate graphics buffering (an additional savings of 32K bytes), and dimension the array as an integer array. Using a real array, the 1040ST ran the Sieve in 90 seconds.

SOFTWARE

The earliest critics of the 520ST bemoaned the lack of software, but the

(continued)

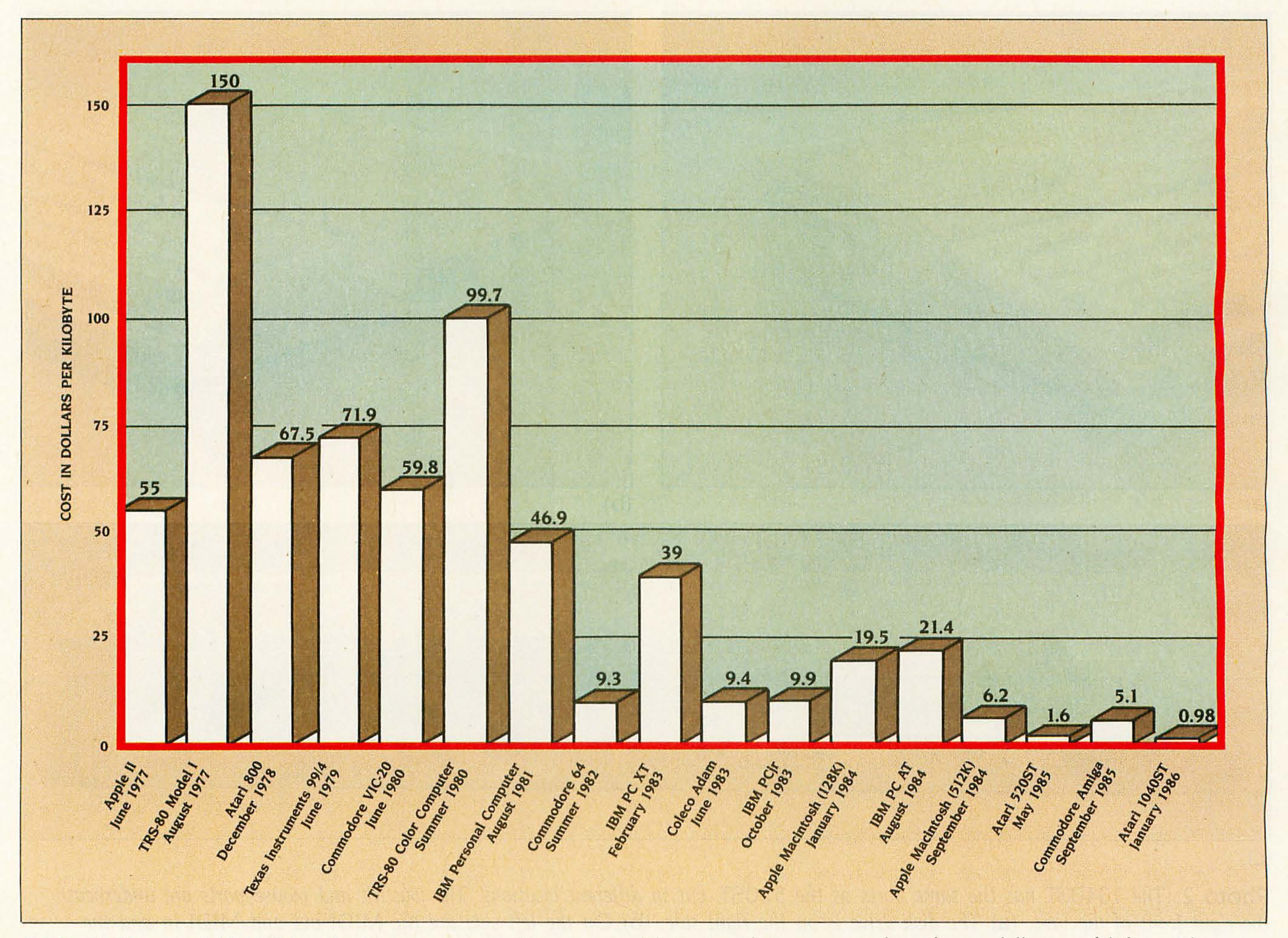


Table 1: *The Atari 1040ST is the first computer with an original list price that represents less than a dollar per kilobyte. The price-per-kilobyte figures were determined by using the original list price for each system on the chart. Prices reflect those for the original system configurations; many but not all of the systems were originally bundled with disk drives and monitors.*

list of available packages has grown and is still growing. The major criticism left is that most of the early products are ports that don't take advantage of the ST's full capabilities. A significant exception is DEGAS from Batteries Included, a full-featured paint package that makes the color monitor worth having (see photo 5).

For those of you who are anxious for information about available software: Michtron has a variety of utilities for the ST machines, including a printer spooler, a RAM disk, and terminal software. SST Systems has Chat, version 1.2, a terminal program with support for XMODEM. A variety of word processors are available, including Mince and Final Word from

For some time, the Atari 1040ST will be the clear leader in price/performance.

Mark of the Unicorn, Express from Mirage Concepts, Haba Writer from Haba Systems, Regent Word from Regent Software, and both 1st Word and ST Writer from Atari. The last of these is in the public domain. DB-Master One from Atari, Hippo Simple from Hippopotamus Software, and Zoomracks from Quickview Systems are database managers. Regent Software also offers a spelling checker with full GEM features. VIP Systems offers The Professional, a Lotus-like spreadsheet. And XLENT software offers Typesetter ST, which supports DEGAS and Neo formats and Prowriter, NEC, and Epson printers.

CONCLUSION

The 1040ST has a remarkable price, and for some time it will be the clear leader in price/performance. Moreover, the graphics coprocessor chip may convince skeptics to take a second look at the ST. Some of our criticisms of the Atari 520ST remain: The desktop is less effective than the

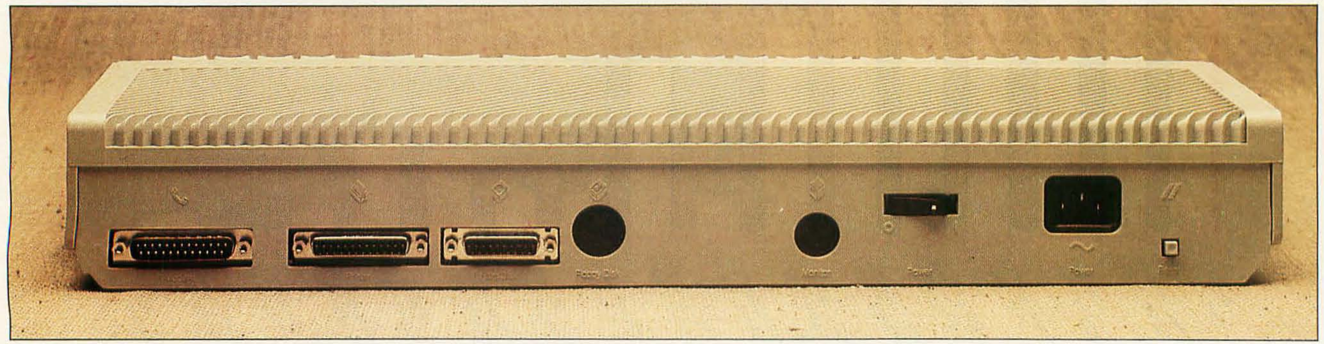
(continued)



(a)



(b)



(c)

Photo 2: *The 1040ST has the same ports as the 520ST, but in different locations. The joystick and mouse ports are underneath the right front of the unit.* (a) *The disk drive is on the right side.* (b) *On the left side are the MIDI out and MIDI in and the 128K-byte ROM cartridge port.* (c) *From left to right on the back panel are the RS-232C serial port, the 25-pin Centronics parallel printer port, the DMA (hard-disk) port, the floppy-disk port, the monitor port, the on/off switch, the AC power connector, and the reset button.*

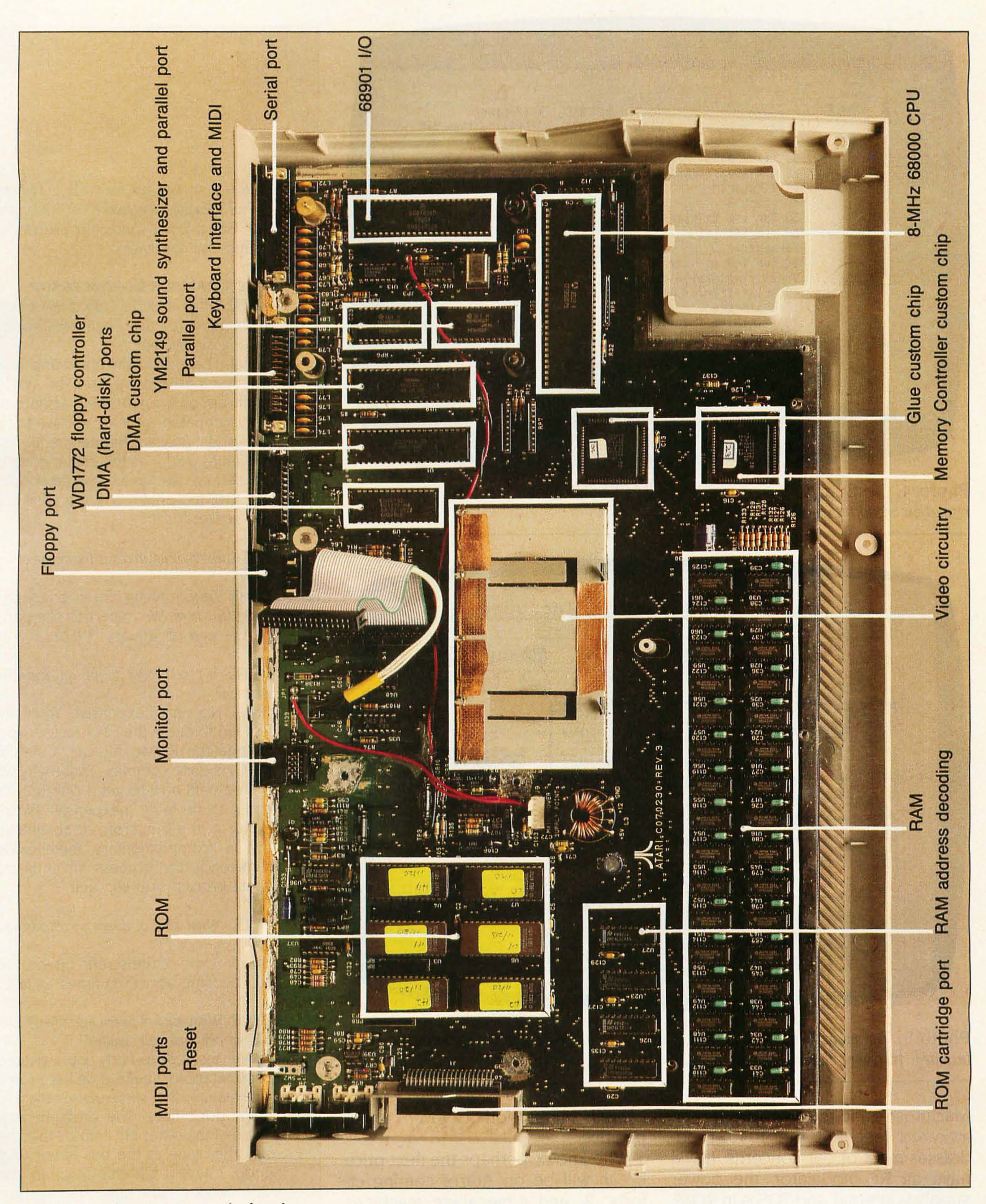


Photo 3: *The* 1040ST *motherboard.*

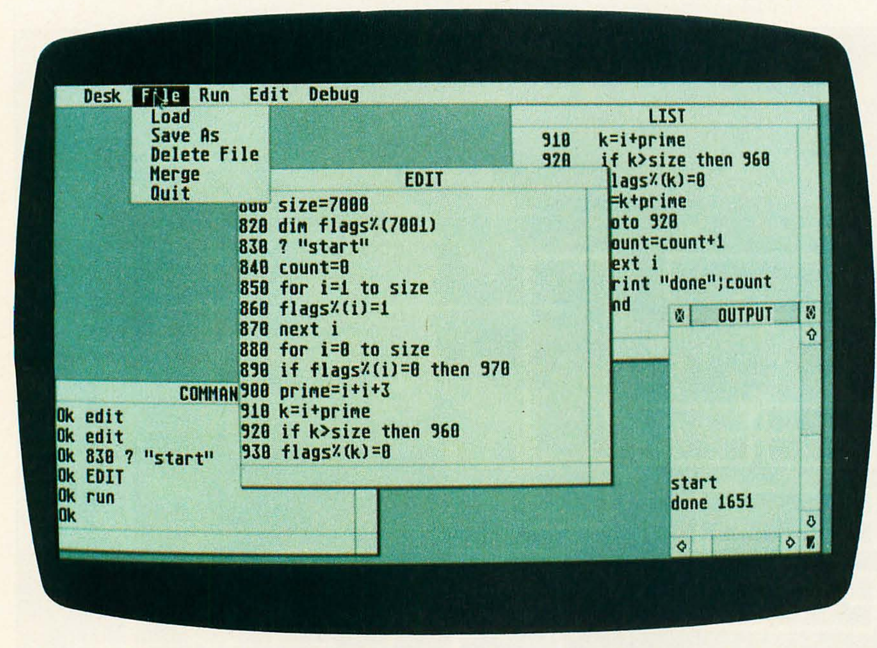


Photo 4: *The Sieve of Eratosthenes in* ST BASIC. *The screen shows the high-resolution monochrome display.*

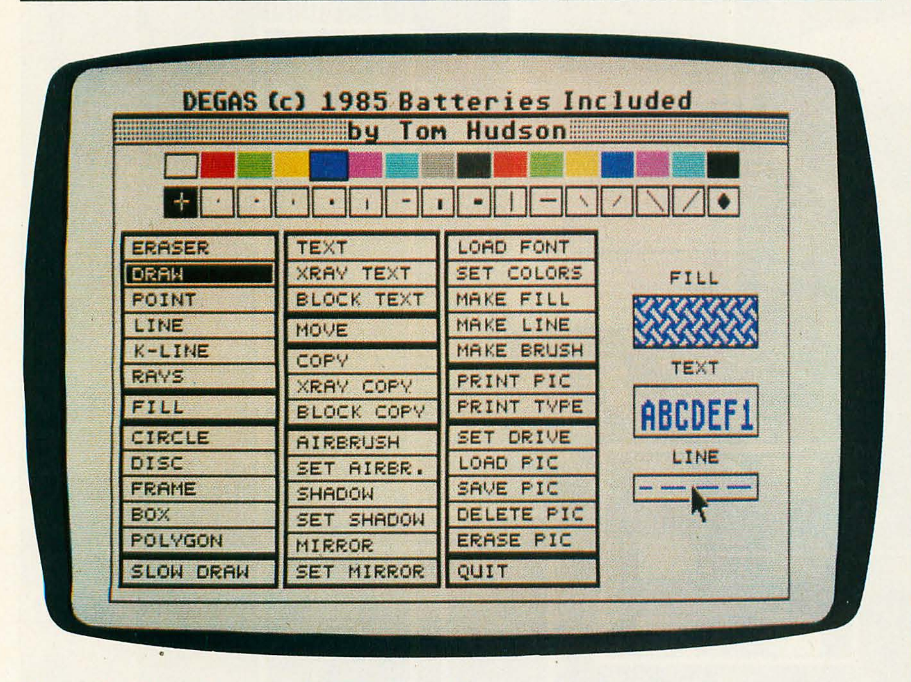


Photo 5: *The main menu of* DEGAS, *a deluxe paint package from* Batteries Included, *in low-resolution color graphics.*

Macintosh's and the keyboard has an awkward feel. But the 1040ST addresses most of our concerns. It will have an RF modulator, the power supply is internal, and TOS is in ROM. And given the outstanding price, our overall impression is even more positive.

Who knows, perhaps the next price break will be on Atari's coming efforts: 2- and 4-megabyte machines and 640- by 592-pixel graphics.

Editor's note: This text box contains portions of Phil Robinson's December 1985 interview with Shiraz Shivji, Atari's vice president of research and development.

THE GRAPHICS COPROCESSOR

BYTE: *Tell us about the graphics coprocessor. When will there actually be a socket waiting for it in the machine?*

Shivji: That's up to the marketing people, but perhaps by April or May. I really am pushing for the machines to be upgradable—at least to have sockets—and it may not happen in the first machines. As far as the engineering is concerned, we have some artwork in the 1040 footprint ready to go that has the socket for it.

BYTE: *How far advanced is the design of the chip?*

Shivji: We're running checks on the layout right now. We expect to see parts by the end of January [1986].

BYTE: *It's not going to be an expensive addition?*

Shivji: No, very inexpensive. You'll only need to put in the coprocessor and change the ROMs. It's not a simple part, it's quite complex. That's why we waited until now to get it out. But it's going to be fairly inexpensive. We're doing it in a 2-micron, double-metal CMOS [complementary metal-oxide semiconductor] process, which is the latest process you can get.

BYTE: *What kind of power will it add and how?*

Shivji: Some of the screen operations will become about 20 times as fast.

BYTE: *What kind of screen operations? Like blitting one area over another?*

Shivji: Yes, it does fairly sophisticated blit operations. I believe we have some nice features that some of the other blit chips don't have. The problem with some of the other blit chips is that the way they glue to the bus is not very good. I have a blit chip from an outside vendor right now that has just

An Interview with Shiraz Shivji

Conducted by Phillip Robinson

come out, but the chip needs a lot of glue around it; in fact, it needs external counters and so on. I would say we do as much as what's in the Amiga chip, and we have some things in it that make it nice in the way it fits on the bus. The cleanliness of the architecture is very important to us. It's a 68-pin PLCC [plastic leaded chip carrier] part. It sits on the bus. It's benign unless it's activated, and then it comes over and takes the bus. But again, a lot of the things like the DMAs [direct memory accesses] are not affected because the DMA will preempt the chip; it has the same priority as the processor.

BYTE: *How does it share time with the processor?*
Shivji: It takes over stuff from the processor, but it doesn't hog it completely. We allow the processor to have a few cycles.

BYTE: *How many gates? Is it a gate array or will it be a fully custom-designed chip?*
Shivji: It will be a fully custom chip. As far as complexity is concerned, I would say it's around 20,000 transistors, so it's medium complexity. One of the things that is important in any design is how you partition things. I feel we have the best partitioning, as good as you can get. And again, it's like the early days of computers where things were hard-wired and the concept of having subroutines came along. That was a tremendous breakthrough—to be able to modularize stuff. This is what I feel we've done on the ST. We are modular. For example, the blit is completely coordinate-free. We will use the same part in the new version of the ST, which is high-resolution. So, it's nice the way we can do those kinds of things and not have it tied to the machine.

Emulating the IBM PC

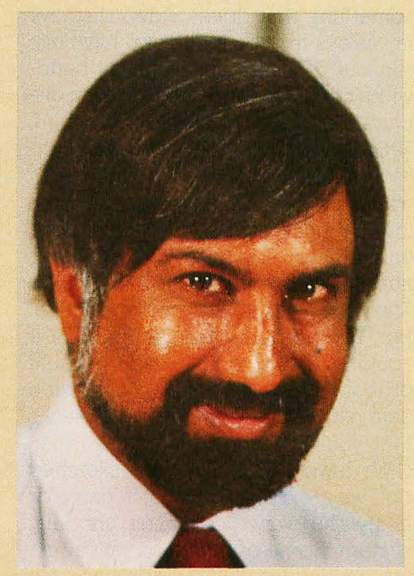
BYTE: *The V20 board that's in the lab for emulating the IBM Personal Computer—is that experimental?*
Shivji: No. We will actually show it at an upcoming CES [Consumer Electronics Show]. In fact, we can either run an 8088 or a V20. We're running it at 8 MHz, and we're going through the DMA channel to get the speed for the display.

BYTE: *You're going through the DMA channel, so this is going to be an external board in a little box?*
Shivji: It's a self-contained box with its own power supply. It will have quite a bit of its own memory. It has the 8088. It also has an 8253 because a lot of people go directly to the timers in the IBM PC. But the problem in any kind of an emulation is the speed of scrolling things on the screen because you have to effectively reproduce what is being done in the PC environment into something else, and it's very slow. We don't think it will be that slow in the case of the ST. Our graphics modes are a superset of the IBM PC's anyway.

BYTE: *Are you using some BIOS [basic input/output system] from an outside source?*
Shivji: Actually, we have the work done on a machine that provides IBM PC compatibility with the 800XL. Initially there was an Atari project that was compatible with the IBM PC, the Apple II, and the 800XL. They eventually abandoned the Apple II compatibility, but they made it compatible with the 800XL. We're essentially following from that effort; we're using a lot of software from that era.

Future Machines

BYTE: *Will the next machine be 2 or 4 megabytes?*
Shivji: We are using the base architecture for future machines. We will have a 2-megabyte version out fairly soon, perhaps in the same case. As you know, the chip is designed to handle 1-megabit parts. If 1-megabit parts are in sufficient quantities, then today we can use sixteen 1-megabit parts; that's a 2-megabyte machine. And if you use 32 parts, which the chip is designed to handle. . . .



BYTE: *You'd just need to have a new board layout, drill new holes.*
Shivji: Yes. And as a matter of fact, it would be easy to upgrade a 1040. . . . 1-megabit parts are 18-pin parts. It would not be that difficult to upgrade your 1040 to make it a 4-megabyte machine by using 1- megabit parts.

BYTE: *How would you do that?*
Shivji: You have two banks, you'd have to remove the chips, but you could do it because it's not that difficult. In fact, we have built a prototype with 1-megabit parts.

Choice of the 68000

BYTE: *About the 68010 and the 68020. You were saying that the 68010 didn't improve ST performance that much.*
Shivji: Not as much. We designed the ST in part as a front end for a compute engine through the DMA channel. That's where we're going to put our compute engine, whatever it is. The people that have bought STs and are buying STs in the future will have the capability of expanding painlessly and using their existing peripherals and everything and get on to a full 32-bit machine such as a 68020.

(continued)

BYTE: *So you're thinking more in terms of a box out back with a 68020 in it and not of an internal 68020.*
Shivji: Yes. We now know how to do a good job in putting a 68000 as part of something that drives video displays in various modes. In fact, we have not run out of steam yet as far as bandwidth of data is concerned for even displays that are 1024 by 1024. We think 1987 is approximately when we might have another generation of machines where the base I/O [input/output] driving the video, and so on, may not be enough, especially if you're talking about 4 to 8 planes of 1024 by 1024. Then you need something like a 68020. But even that is not enough. You couldn't run just raw 32-bits. You would probably have 64- and 128-bit-wide data paths to take care of all the planes that you're talking about.

We have the architecture sketched out; we are doing the custom parts for it. By the way, these parts are fully custom. Some of the chips we've met are really huge. You wouldn't be able to do it even with semicustom. You certainly could not use gate arrays; there's no gate array built at the moment that can handle one of the chips we're talking about. It would be the equivalent of about 25,000 gates. It's also very high speed. We're looking, in some cases, to run things at about 100 MHz.

BYTE: *Do you have to go to bipolar then in the custom chips?*
Shivji: We will actually have custom chips at 2-micron, double-metal CMOS. But then there's going to be an interface chip to drive external things. The reason we can go to high speeds is because the structures we're using are very regular. There's no loading. Supposing you run a shift register. There's no loading in between cells. All you're doing with a flip-flop cell is driving another cell, and so on. You can get quite a bit of performance if you use such a structure, and we're using a similar structure.

BYTE: *And when you're at 2-micron, too.*
Shivji: Yeah, 2-micron double-metal is quite fast. So we can run close to 100 MHz, but only on a small section of the chip. Everything is not running at that speed.

CD-ROMs and Floppies

BYTE: *What about the disk memories? the CD-ROM?*
Shivji: We're waiting for audio. The first version of the CD-ROM players was a small unit; the power supply was a separate box. The second batch has a built-in power supply. Now Sony has a third batch, starting around April, which has audio as well as digital. That's the one that we're waiting for. We feel that if a customer spends $600, he might as well have audio, too.

BYTE: *What about the floppies? Is there going to be a change at some point, going to higher densities, 1.2 megabytes?*
Shivji: Two megs is almost here. The thing that's going to be important is the media, because it is special media that can handle 2 megs. Some of our Japanese friends who are drive manufacturers are working on a 10-megabyte floppy in the 3.5 format. They think that sometime around mid to late 1986 there will be 10-megabyte drives.

Multitasking

BYTE: *What about multitasking? When will that be coming as an option, or do you see that as necessary at all?*
Shivji: To get useful multitasking you have to have things like protection, which is not the case in many existing machines. Although we have protected space, as you've noticed, it's not very much. The architecture is there to provide more protection, and in future versions of the machine we may provide a lot more protection.

BYTE: *That's why you're looking at the memory-management chips and such?*
Shivji: Yes, we're looking at memory-management chips, but doing logical-to physical-address translation is perhaps not as important as the protection feature for multitasking. So we're looking closely into protection. Again, the future versions of the ST architecture could have more; we have only 2K bytes at the moment, and we could probably protect about half a megabyte. And then that would make it a lot easier to run a protected kernel and then multitask.

BYTE: *What about UNIX System V?*
Shivji: We're looking at System V now. We're constantly looking at multitasking, and we're constantly getting proposals for a multitasking environment. As a matter of fact, I think it has become a bit of a buzzword. But it is something that people now are looking forward to having in their machines. So with the amount of memory the 1040 has, it will not be out of place to have a multitasking operating system that could run, coexist with TOS perhaps, by at least the third quarter of 1986.

BYTE: *What about peripherals? Is Atari going to get in the business of printers and modems and the like?*
Shivji: Yes, we have printers. We are working on a modem. We feel that a 1200-baud modem should be inexpensive. There have been a lot of advances in technology (such as the modem chips from Sierra Semiconductor). We hope that around the middle of 1986 we will have something to show.

BYTE: *What about higher-end printers? With Atari leading this price/performance curve now, what about laser printers?*
Shivji: We started talking to the people, around the time that the laser printers came out from Apple and Hewlett Packard. We have talked to a lot of the manufacturers. We're looking at something that costs about $1200 retail, but we don't feel that it's really a mass item. Although imagine an ST in an engineering environment where you can get prints.

Yes, we were looking at it. As a matter of fact, the interesting thing is that the cost of building the ST board is so low that we were thinking of using the ST board as a driver for the printer. At 300 dots per inch, if you want to have a full page in the unit, you've got to have about one and a half meg of RAM. And we actually can support more than that. It's something that's in the pipeline. We unfortunately don't have control over the manufacturers. We actually looked at the LCS technology—the liquid-crystal shutter—which is similar to that. Casio uses that. It wasn't quite as good. Nowadays people are also pushing the LEDs [light-emitting diodes]. The company that is farthest along the line of good printers in LEDs is NEC. They have a really nice

one. We've been talking to them about getting their engine for quite a while. But right now it's too expensive. We could probably get it down to about $1500 right now. We're looking more toward $1200 and then under $1000.

BYTE: *What about sound capabilities?*
Shivji: We had a project here started during Alan Kay's tenure—a chip called Amy. And the ST was designed to have the Amy. But the Amy did not happen. We had silicon, the first pass, in October or November, and we had severe problems with it. It was kind of an orphan project. There were a lot of people who had worked on it. And if you have a chip that has six or eight people who have worked on it at different times, chances of the chip working are slim. But it's a good design.

BYTE: *What does it do? What's so special about it?*
Shivji: The approach of others is that during horizontal-refresh time you go out to some place and put some memory out automatically, and that goes through a DAC [digital-to-analog converter] and you have sound. Essentially you're sampling at 15.75 kHz, which is the typical frequency. So it's like a digital tape recorder. You have a digitized sound and you're just putting it out. And it needs enormous amounts of memory. The key is: How do you encode sound? From an information-theoretic point of view, there are two problems with this approach. One is it's an enormous waste of memory. Because you could encode whatever sound you're going to play, as far as data is concerned in a sound piece, the data rate is extremely low. And doing it in the digital tape recorder way, you're wasting an awful lot of bandwidth and a lot of memory. The second problem with other implementations is that you only have 8 bits and it's not really that good. Especially with CDs coming out.

Amy was a chip that had 16 bits of information coming out. So you could have 96 decibels of range. What you could hear! Amy was a complete digital sound chip. It's called an additive-digital synthesizer. It had an adder and 64 independent oscillators. It has a model for sound and you feed it the parameters. But if you do that you have to do an awful lot of preprocessing. We had hired a lot of people. We had a VAX 780 devoted to it. We had equipment, fast floating-point array processors, and so on, to analyze notes. We would get a tape of piano playing and then the VAX would analyze it and would take the Amy model and give the parameters. To play anything you only needed to have parameter tables and feed it to the chip.

BYTE: *Is it still a possibility then?*
Shivji: It is still a possibility. We were going to have the Amy, and then it didn't happen. Then we said, look, we want to have a base machine that's a good machine. Everybody doesn't really care about great sound, right? So let's not penalize people that don't care. Let's put something that will allow people who really care about sound to be able to play things. That's how the MIDI came in. And so if you get Amy, we could even have it out as a MIDI device. It's a great chip. Essentially all you do is you load it up. Off line you're doing an analysis of all the different things, and then you have it in table form. And you can play it any time you want. And you're not using up the bus that much.

BYTE: *If it has that kind of processing capability, it could probably build models for voice, too.*
Shivji: Exactly. We actually could reproduce opera sound. As a matter of fact, we had a sound lab. The type of sound that you could hear from that chip was just incredible. Again, 16-bit. Actually, the chip could even give you 17 bits if you wanted it to. The two problems are it needs too much memory and it hogs the bandwidth. The bandwidth you could probably get around. However, that's not the whole thing. You still have to move all that data around. Of course you don't get the data at the right place for free. For example, you have to move it somehow from a disk drive.

BYTE: *So the Yamaha chip is in there just to give it the basic sound?*
Shivji: Yes, just the basic sounds you need. Though, of course, the ports are very useful. ■

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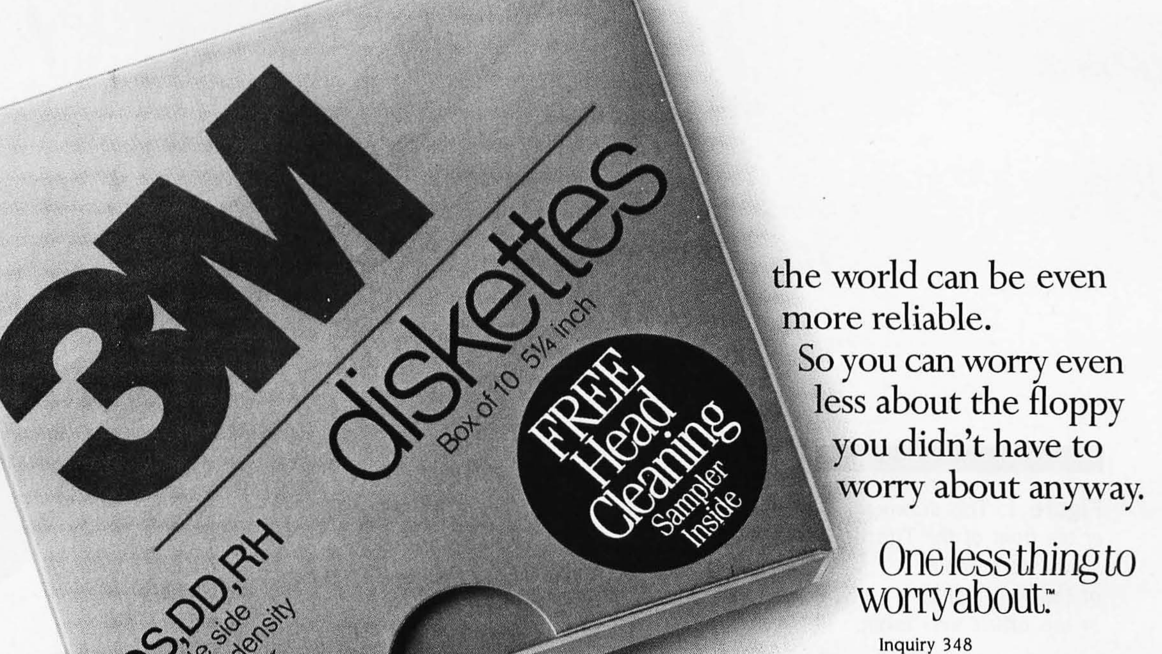
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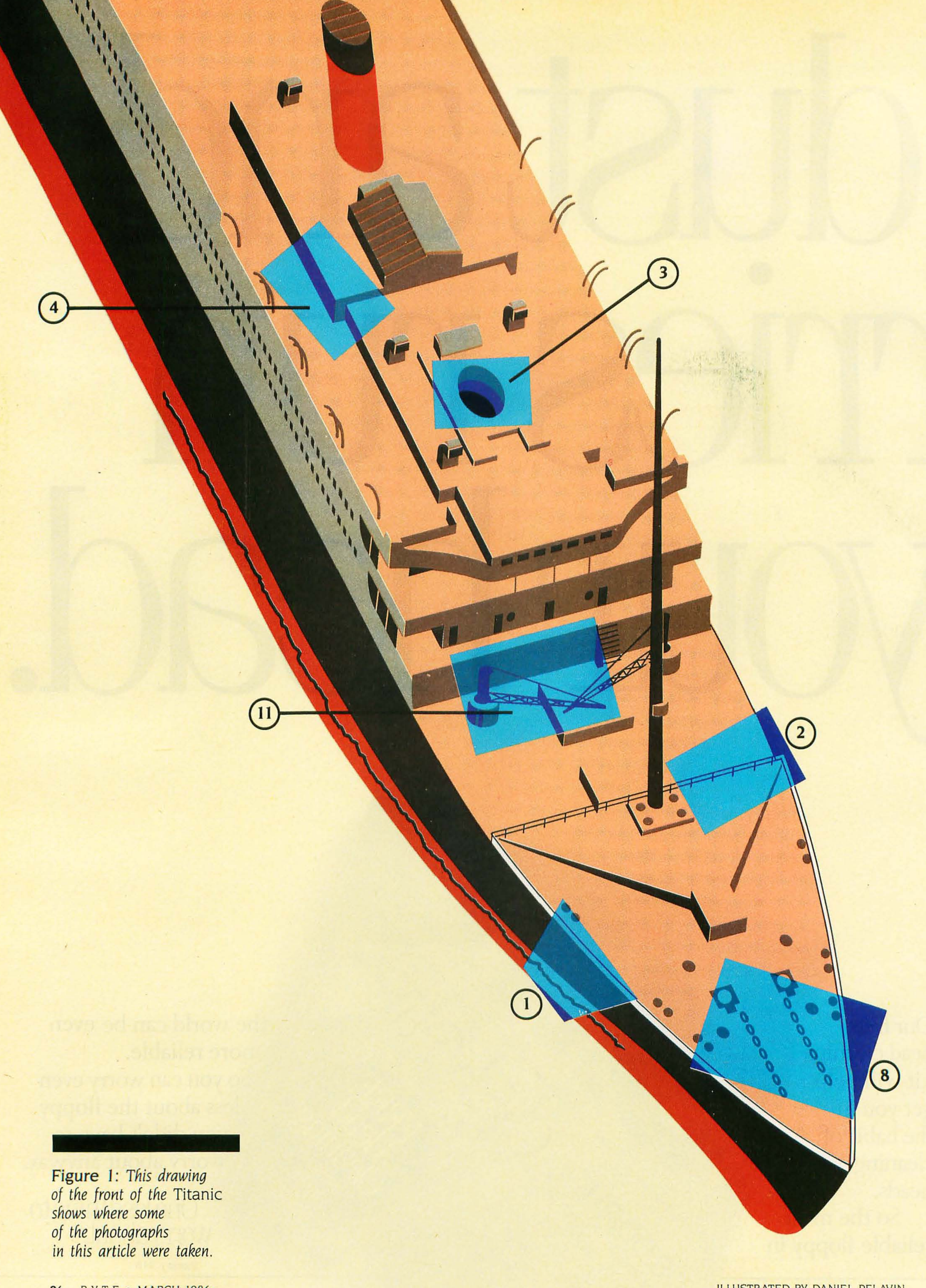


Figure 1: *This drawing of the front of the* Titanic *shows where some of the photographs in this article were taken.*

ILLUSTRATED BY DANIEL PELAVIN

BY MARTI SPALDING AND BEN DAWSON

FINDING THE TITANIC

Image processing helped locate the historic wreck

On April 14, 1912, the "unsinkable" *Titanic* sank when it collided with an iceberg in the North Atlantic, taking with it more than 1500 of its 2000 passengers. When the *Titanic* slid into its grave, the technology of the day could indicate only that it sank somewhere in a 150-square-mile area of the Atlantic Ocean. The combination of such a large search area and the tremendous depth of the water frustrated attempts to find the ship.

Then, after 73 years of being lost in the vast and frigid waters of the Atlantic, the *Titanic* was located 370 miles south of Newfoundland on September 1, 1985, at 13,000 feet (more than 2 miles) below sea level. The team that found her consisted of 13 researchers aboard the U.S. Navy vessel *Knorr*, a group of French scientists from the vessel *Le Suroit*, and millions of dollars worth of equipment. The success of this expedition was due largely to advances in deep-sea exploration and image-processing technology.

HOW DO YOU FIND A SUNKEN SHIP?

The French ship *Le Suroit* was equipped with an advanced remote-acoustic system (SAR) that was originally developed for finding valuable manganese nodules on the ocean floor. As the ship moves, the SAR side scans kilometer-wide strips of the ocean floor. The system synthesizes these high-resolution strip images to provide a continuous two-dimensional image.

Using the SAR, the French examined most of the 150-square-mile search area but missed finding the *Titanic* by 300 yards.

Le Suroit certainly *could* have located the *Titanic* or its debris but might have had trouble making a positive identification. Because SAR images are two-dimensional, they do not allow you to determine the height of an object on the ocean floor unless the object casts a shadow. As with an optical shadow, you can estimate the height if you know the viewing angle and distances. If the *Titanic* were not intact or viewed from the proper angle, identification might have been difficult even if the SAR had located it.

Meanwhile, the Americans explored using the Argo, named for the ship sailed by the Greek hero Jason in his search for the Golden Fleece. The Argo is a 15-foot-long unmanned vehicle developed at the Woods Hole Oceanographic Institution in Massachusetts as part of a system for ocean-bottom research. It acquires wide-angle television pictures while "flying" 120 feet above the sea floor and zooming in for close-up shots.

With only a few days remaining in

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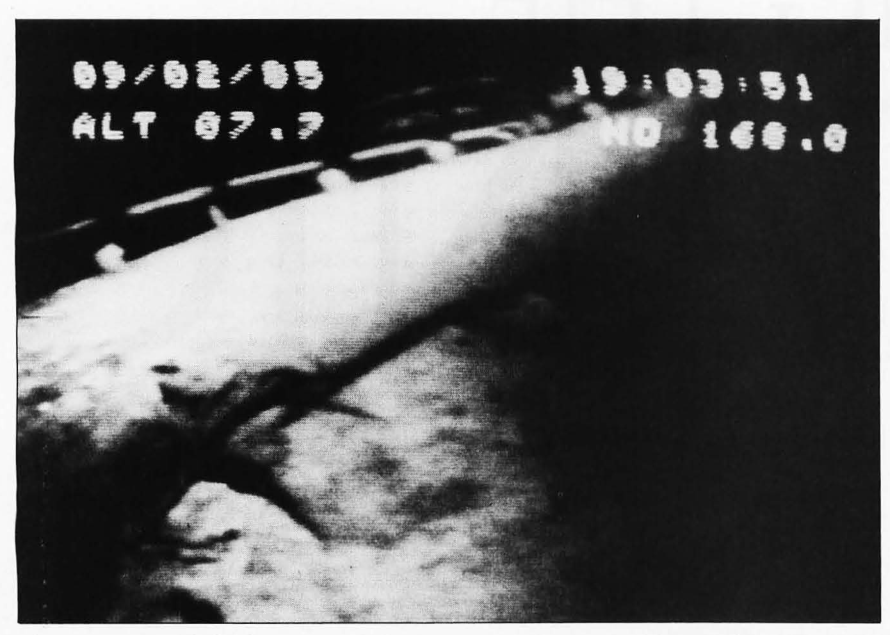


Photo 1: *One of the first views of the* Titanic *seen since it sank into the frigid waters of the* North Atlantic *almost three-quarters of a century ago. This video image was taken by the* Argo *from approximately* 25 *feet above the wreck and shows the gash in the bow area where the iceberg struck. The time-code numbers along the top of the image are blurred due to the averaging process.* (All *photos and figures courtesy of the* Woods Hole Oceanographic Institution.)

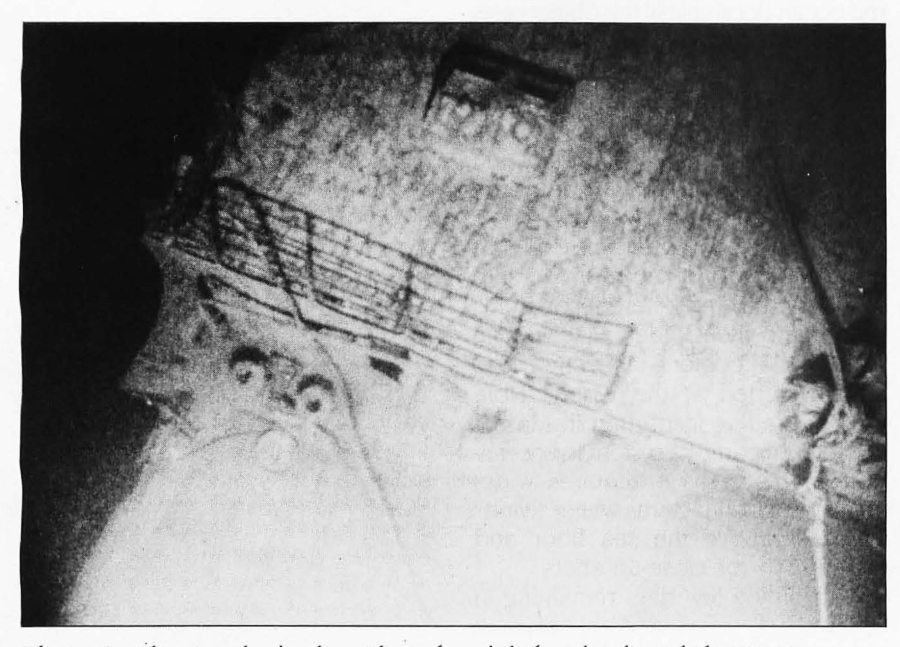


Photo 2: *This view clearly shows the teakwood deck and railing of the* Titanic. *Photos* 2 *through* 6 *are* 35*mm photographs taken by the ANGUS. Although they are of much higher quality than the video images used to locate the* Titanic, *the* 35*mm images are somewhat cloudy due to light scatter from particles in the water.*

the expedition, the Argo started sending back video images of the debris from the *Titanic*. Within hours the researchers had found and identified the wreck of the *Titanic* itself (see photo 1).

Because the video images provided by the Argo were of relatively poor quality, the researchers dispatched a second towed vehicle, the ANGUS (acoustically navigated geological underwater survey), which zoomed in and took high-quality 35mm photographs. The ANGUS was designed primarily to work in rugged volcanic terrains to depths of 20,000 feet. The ANGUS's depth is controlled by the amount of tow cable let out and typically flies 25 to 35 feet above the ocean floor. Its heavy-duty steel frame must be capable of withstanding jarring head-on collisions with rock outcrops, because it sends no visual information back to the surface ship.

Within the ANGUS's frame are three large-capacity 35mm color cameras, each containing 400 feet of film (3200 photos) and capable of photographing a swath of sea floor about 200 feet wide. These cameras take photographs at 20-second intervals, using strobe lights to illuminate the ocean bottom. At the speed at which the ANGUS travels, this rate provides a generous photo overlap. (Photos 2 through 6 were taken by the ANGUS. Figure 1 shows the approximate site of the photographs in this article.) The ANGUS must be pulled up on board the *Knorr* and the film processed before the images can be viewed.

GETTING PICTURES FROM THE ABYSS

The Argo (see photo 7), with its ability to send real-time video images to the *Knorr*, was the key to finding the *Titanic*. Even after the French had explored and eliminated 80 percent of the search area, a large area remained. Real-time video imaging allowed the researchers to do a rapid search of the ocean floor and obtain a positive identification of the wreck, which could not have been done with the delays inherent in processing film from the ANGUS.

The Argo carries three video cameras, strobe lights and floodlights, a sonar system, and a variety of electronics (see figure 2). One camera looks forward while the other two look down. A video switcher selects a camera signal for transmission up the tow cable to the *Knorr* where video images are then processed, monitored, and recorded. The sonar system on the Argo is similar to the French SAR system but has lower resolution and is used to augment the video capabilities. The Argo's depth is controlled by changing the length of the tow cable.

The Argo uses two modes of operation. In snapshot mode, the strobe lights fire every 10 seconds to survey a wide area of ocean floor. The Argo is towed at a speed of 0.6 to 2.4 miles per hour (0.5 to 2 knots) so that successive video snapshot images overlap. When the researchers locate something of interest, they lower the Argo and use a continuous mode of operation. In this mode, two 250-watt floodlights illuminate a smaller section of the ocean floor, as the cameras send continuous video images back to the *Knorr*.

In shallow water, the design for an Argo-like vehicle would be simple: Attach TV cameras and lights to a frame, and send the video pictures back through a coaxial cable to the surface ship. With a deep submersible vehicle, however, two factors—the ocean environment and the tow cable—make this design a formidable problem.

The environment at great ocean depths is in some ways more hostile than the vacuum of space. The water is completely dark and its pressure crushes any unprotected equipment. In addition, the conductive and corrosive properties of salt water destroy equipment or quickly make it unreliable. Solutions to these problems included enclosing the electronic equipment in heavy-pressure housings and connecting equipment with pressure-compensated oil-filled cables. The small size of the housings and the cost of this protection constrained the amount of electronics that could be placed aboard the Argo.



Photo 3: *The gaping hole left by the collapse of the* Titanic's *first (forward) smokestack. The huge liner had four smokestacks.*

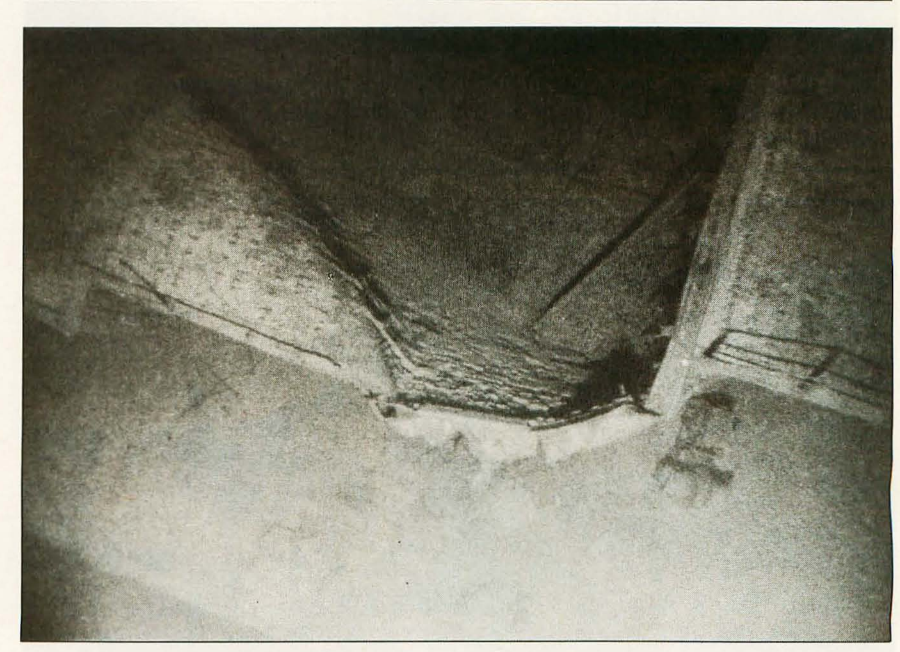


Photo 4: *An area of major damage between the first and second smokestacks.*

Ocean water contains a large amount of suspended particles (such as dirt and silt) that reflect illuminating light and partially blind the cameras. The problem is similar to using headlights in fog. The designers of the Argo reduced these reflections by mounting its lights and cameras as far apart as possible. In a similar way, fog lights on a car are usually mounted as far below the driver's eyes as possible.

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At these tremendous ocean depths, the design of the tow cable is a major problem; let's consider what the cable must do. It must support thousands of pounds of equipment, operate under tremendous water pressure, and provide an electronic path for all power delivered to the Argo and the control, telemetry, and video signals sent between the Argo and the *Knorr*. In shallow water, you could use multiple cables for these functions. At any great depth, however, multiple cables are unmanageable. The design of the Argo required that all the support, power, and signal functions be built into a single coaxial tow cable.

The tow cable consists of a single center conductor surrounded by a coaxial shield and a waterproof barrier wrapped in two layers of steel armor. The steel armor prevents the cable from being crushed by the water pressure. The cable is 0.68 inches in diameter and 20,000 feet long, and it weighs over seven tons.

The cable's weight becomes a major problem when handling and testing it—the cable spool literally sinks into pavement or floors. The cable can support 40,000 pounds of properly terminated load, a substantial portion of which is its own weight. Because the cable is unwound from a spool, all electrical connections must be made through rotating contacts. A single coaxial cable can withstand repeated flexures and other abuse better than a multiconductor cable and makes the design of the rotating contacts simple and reliable.

Power for the Argo's equipment is transmitted down the tow cable using 440 volts AC. At the same time, control signals are sent down the cable and telemetry signals are sent up the cable (including one channel for the video information). Frequency-division multiplexing allows the power and signals to travel on a single cable. That is, the power and each of the control and telemetry signals occupy a different frequency band in a 5-MHz total bandwidth. Modulators shift signals to appropriate bands, and demodulators recover the signals at the receiving end.

The problems with this scheme include limited power transmission, noise, and limited bandwidth for signals. The limited amount of power that can be sent down the cable means that in snapshot mode, the strobe lights have to charge for several seconds before they can fire; in continuous mode, only 500 watts of illumination is available.

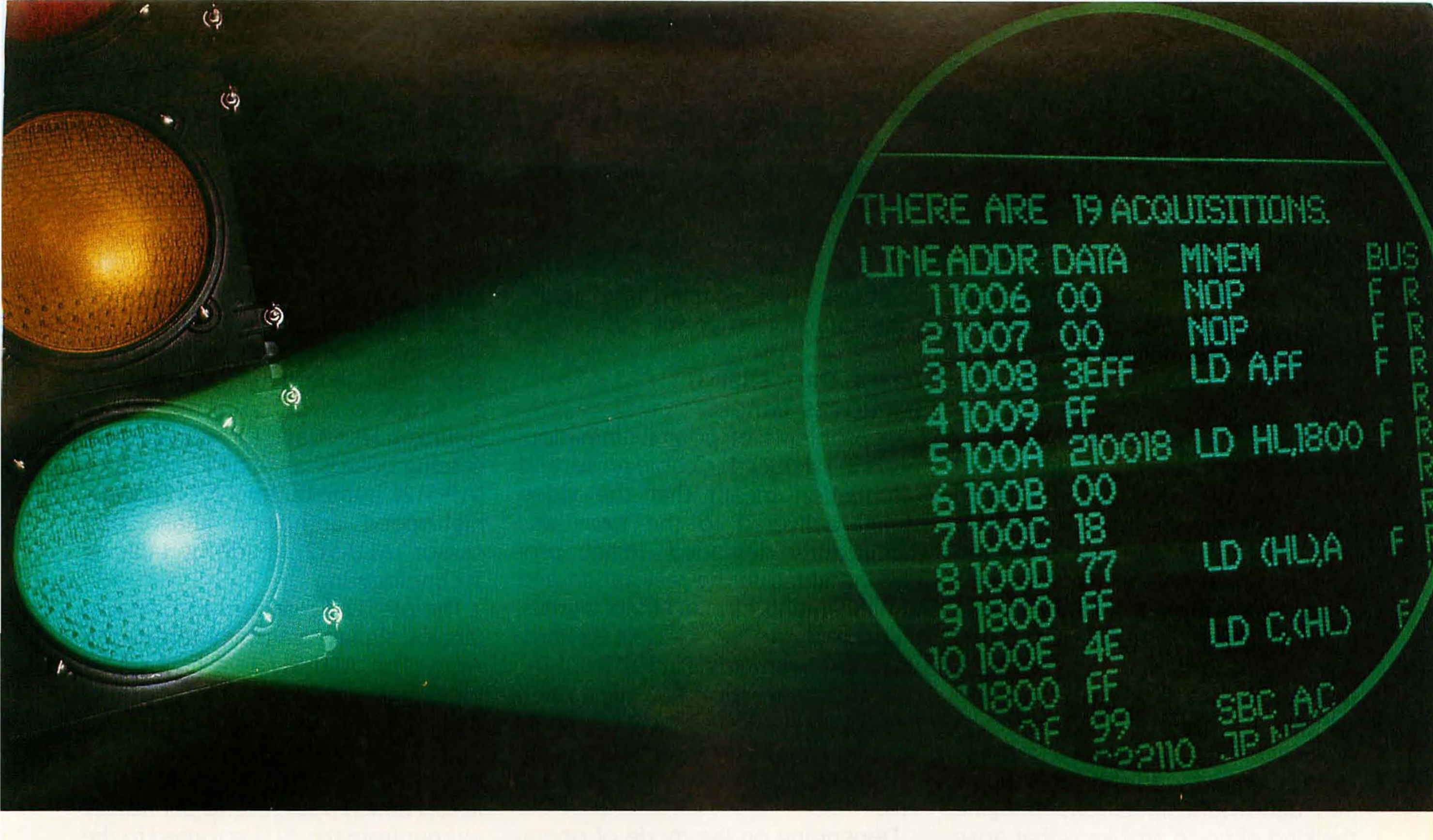
The researchers on the *Knorr* made

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Photo 5: *Some of the debris surrounding the* Titanic. *The serving tray is about 3 feet across. The black lumps are coal. The ocean bottom at these depths is usually featureless.*



Photo 6: *This twisted machinery is the base of the aft crane. Surprisingly, some items (the serving tray and wine bottles) were gently deposited on the ocean floor, while others were ripped off the ship and destroyed.*



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the best use of the Argo's limited power by switching between the two modes. In snapshot mode, the Argo briefly illuminated a large area to allow a survey, while for close-up viewing it continuously illuminated a smaller area. To maximize the limited light available, the system utilized highly sensitive Silicon Intensified Target (SIT) video cameras. While the comparison between film and video is not exact, the approximate sensitivity of these cameras is 200,000 ASA (an ISO [International Organization for Standardization] film-speed rating).

The video signals returned from the Argo are degraded by cable noise and bandwidth limitations. Imagine the kind of noise problems that arise from running 440 volts AC on the same line as a video signal! Again, the bandwidth of the cable is only 5 MHz, so to transmit all the power and signals the video signal had to be modulated at 5 MHz. Half the video signal occupied the frequency band between 5 and 10 MHz, which was well past the bandwidth of the cable. Thus, at 5-MHz frequency, the cable attenuated the video signal by 80 decibels, which resulted in a significant reduction in power.

IMAGE PROCESSING IMPROVES IMAGES

The problems of poor illumination, particle backscatter, cable noise, and attenuation meant that the video signal delivered to the *Knorr* was significantly degraded. Image processing aided in the restoration and enhancement of the video signals. Figure 3 shows the specialized hardware configuration used to capture, transmit, and process the video images obtained from the Argo. Some common image-processing terms are explained in the glossary on page 110.

Depending on the mode of operation, the Argo sends the output from its cameras directly up the tow cable to an analog video preprocessor or temporarily stores it in a *frame store* located aboard the Argo. This frame store is a modular 5½-inch-high unit (manufactured by Toko Inc.) that is small enough to fit into a pressure housing. On the *Knorr*, the analog video preprocessor reinserts synchronization signals to correct for losses caused by the frequency-modulation telemetry system.

Image processing and control equipment aboard the *Knorr* includes a single-board computer, the Heurikon HK68, and three image-processing boards: an analog processor (AP-512), frame buffer (FB-512), and a high-speed arithmetic image processor (ALU-512), made by Imaging Technology Inc.

The AP-512 *digitizes* the video images (analog signals) transmitted from the Argo. The ALU-512 is a high-speed pipelined processor that supports real-time full-frame arithmetic and logical operations (such as add, subtract, AND, and OR) on video images in real time (1/30th second per frame). Output from the ALU is routed to the FB-512 frame buffer for storage.

The FB-512 is a general-purpose frame buffer that stores the resulting digitized image in its 256K bytes of RAM (random-access read/write memory) as 512- by 512-bytes by 8 bits (RS-170 specification results in the image being acquired and displayed as 480 lines). This module stores and outputs a digitized image in real time, at a rate of 30 frames per second.

The image-processing system was controlled by the HK68 68000-based computer running VRTX (Versatile Real-Time Executive), a real-time multitasking operating system. This board has 1 megabyte of memory and allows DMA (direct memory access) transfer of images between CPU (central processing unit) memory and the FB-512 frame buffer. A second Heurikon HK68 system on the *Knorr* was used for modifying this software while the ship was at sea.

VRTX manages the assignment of memory and the input/output of data in a real-time system environment. As such, it functions somewhat like a switchboard operator, making sure that priority calls are handled immediately and that other calls are answered as soon as possible without allowing any call to fail to get answered. VRTX helps direct data transmission between the Argo and the *Knorr*, helps control the Argo and

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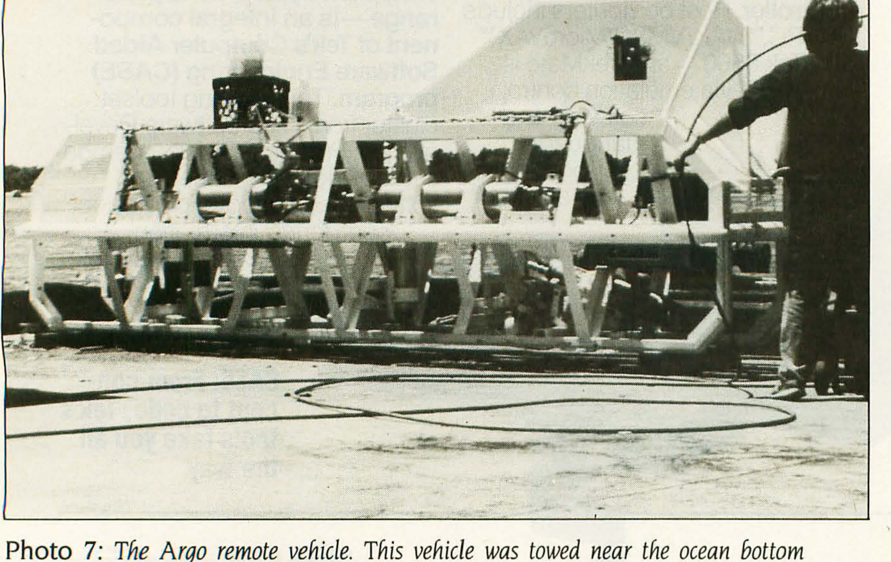
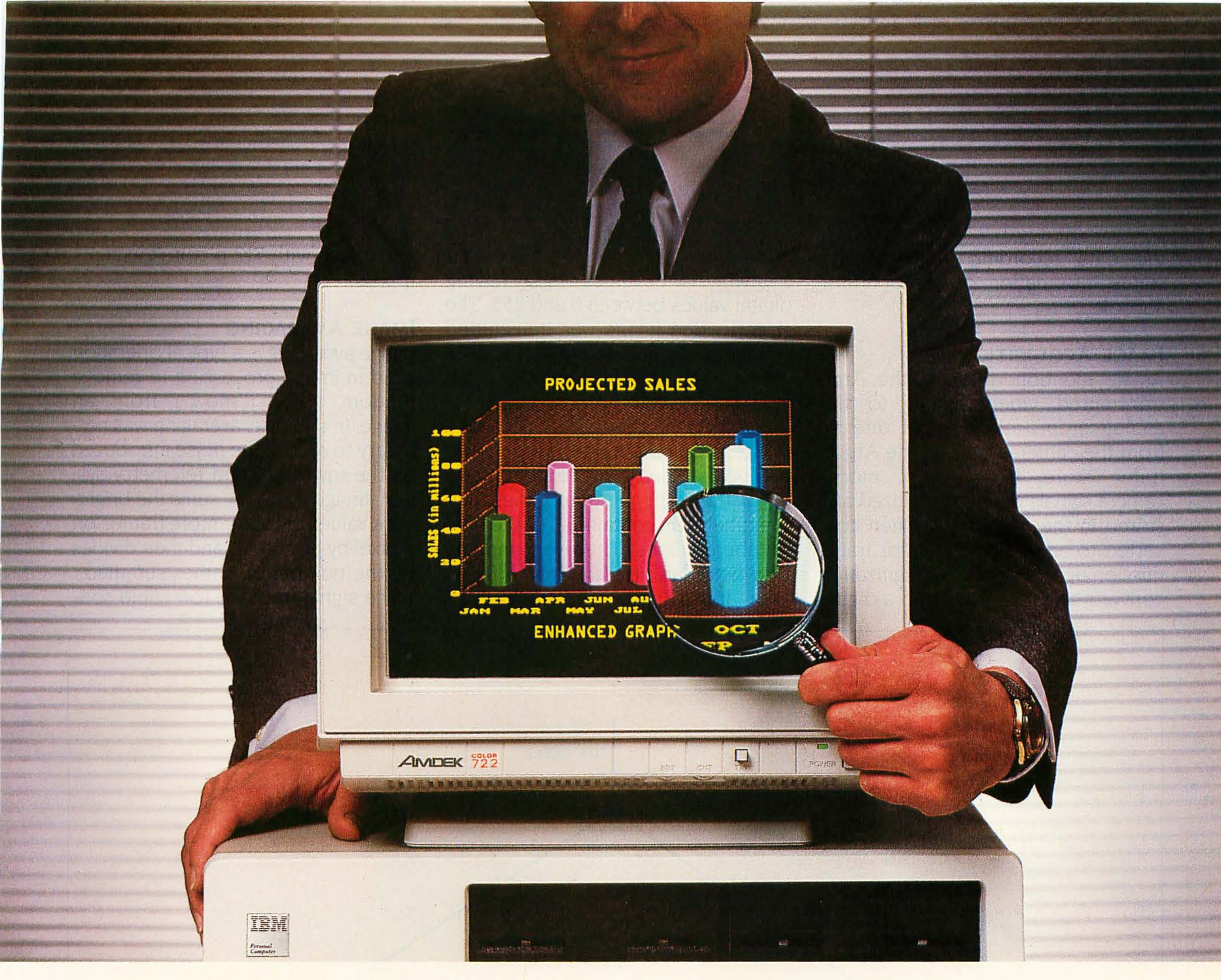


Photo 7: *The Argo remote vehicle. This vehicle was towed near the ocean bottom and sent back video images of the* Titanic. *The cylindrical pressure housings hold cameras, strobe lights, and other electronics.*



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IMAGE ACQUISITION

As we mentioned earlier, the Argo transmitted video signals to the analog preprocessor either directly from the cameras or from the Argo's frame store. In snapshot mode, camera signals were first digitized and stored in the frame store, then converted to an analog signal for transmission up the tow cable. Digitization converts an analog signal to a digital code, where 0 represents black and 255 white, with values of gray having digital values between 0 and 255. The stored video image was transmitted continuously up the cable and processed, as explained below, to improve its quality.

In video terminology, one video image is called a frame. A frame has two fields; one of the fields contains all of the even-numbered lines, and the other field contains all of the odd-numbered lines. The even and the odd fields are *interlaced* into a frame with approximately 480 horizontal lines, each with 512 picture elements (pixels).

IMAGE AVERAGING

Image averaging is a typical operation used in image processing to remove random noise ("snow") from an image. In this case, averaging was necessary to reduce the noise introduced by the tow cable and telemetry system. Image averaging sums the brightness values of two or more frames on a pixel-by-pixel basis and then divides by the number of frames summed.

The signal from the tow cable con-

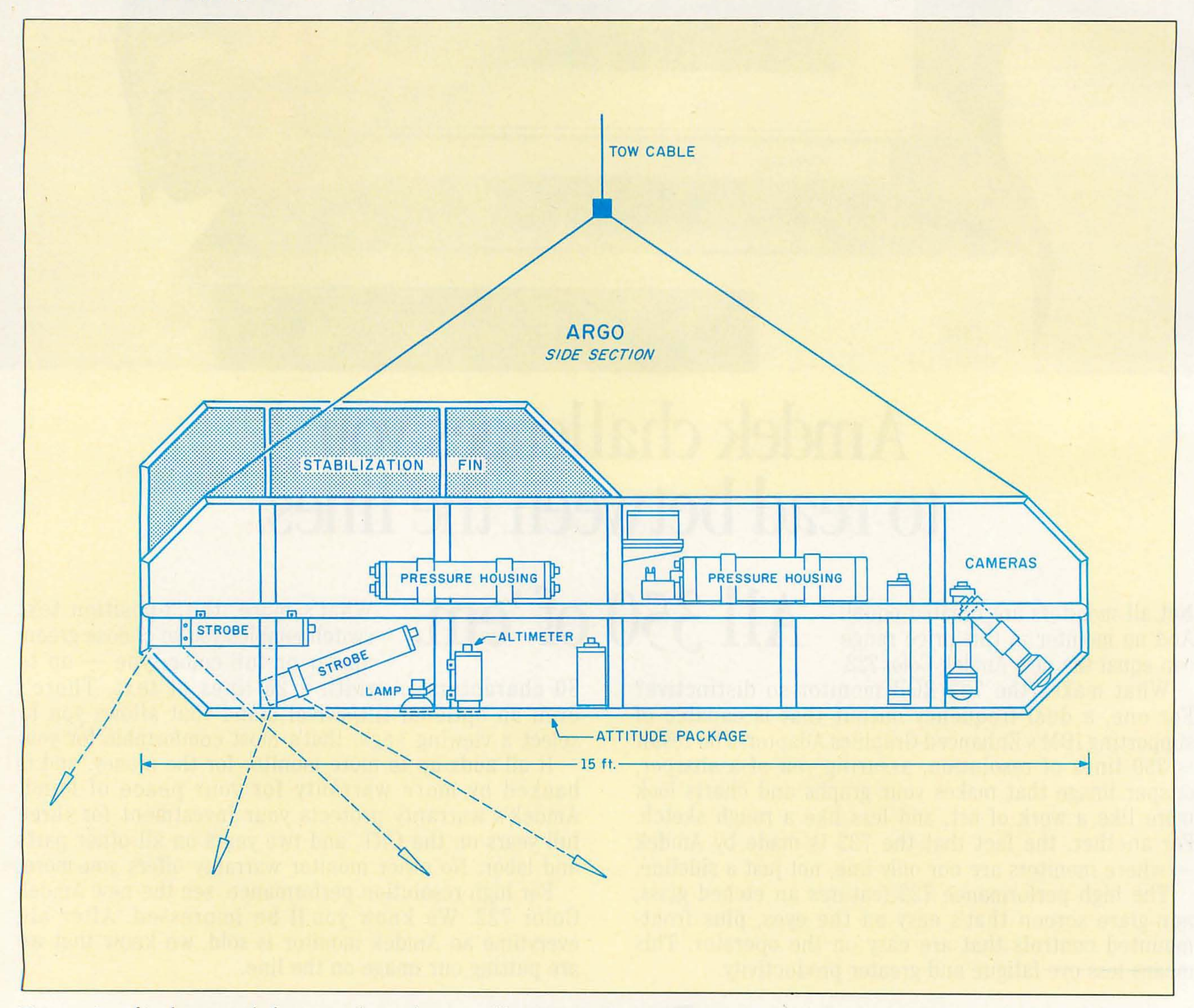


Figure 2: *This drawing of the Argo shows the tow cable, pressure housings, cameras, and lights. Other housings hold the altimeter, attitude package (depth, heading, heave, etc.), and control and communication electronics.*

sists of the desired video signal plus the added random noise. These random-noise values may either increase or decrease the digital value of the desired video signal and appear in different spatial positions from frame to frame. When the system sums the tow cable signal values, the random-noise values tend to cancel but the desired video signal increases. The final division scales the sum back to a range that can be displayed on a television monitor. The actual increase in the signal-to-noise ratio is proportional to the square root of the number of images averaged if the noise is completely random. The result of averaging two or more frames of the same noisy image is a much clearer picture.

Consider the values of a single pixel in a sequence of eight frames. Suppose that the correct signal value for this pixel should be 5, but noise values of −2, 0, and 2 are being randomly added to the signal. A typical sequence of frame values for this pixel might be

5 7 3 3 7 5 7 5

The sum of the pixel values is 42 and when divided by 8 the average is 5.25. This estimate is very close to the correct signal value of 5. The limited range of numbers represented in the frame buffer truncates the fractional value to 5.

From a hardware standpoint, the video signal was digitized by the AP-512 analog processor and summed with existing values contained in the FB-512 frame buffer by the ALU-512 arithmetic logic unit. These summed values were returned

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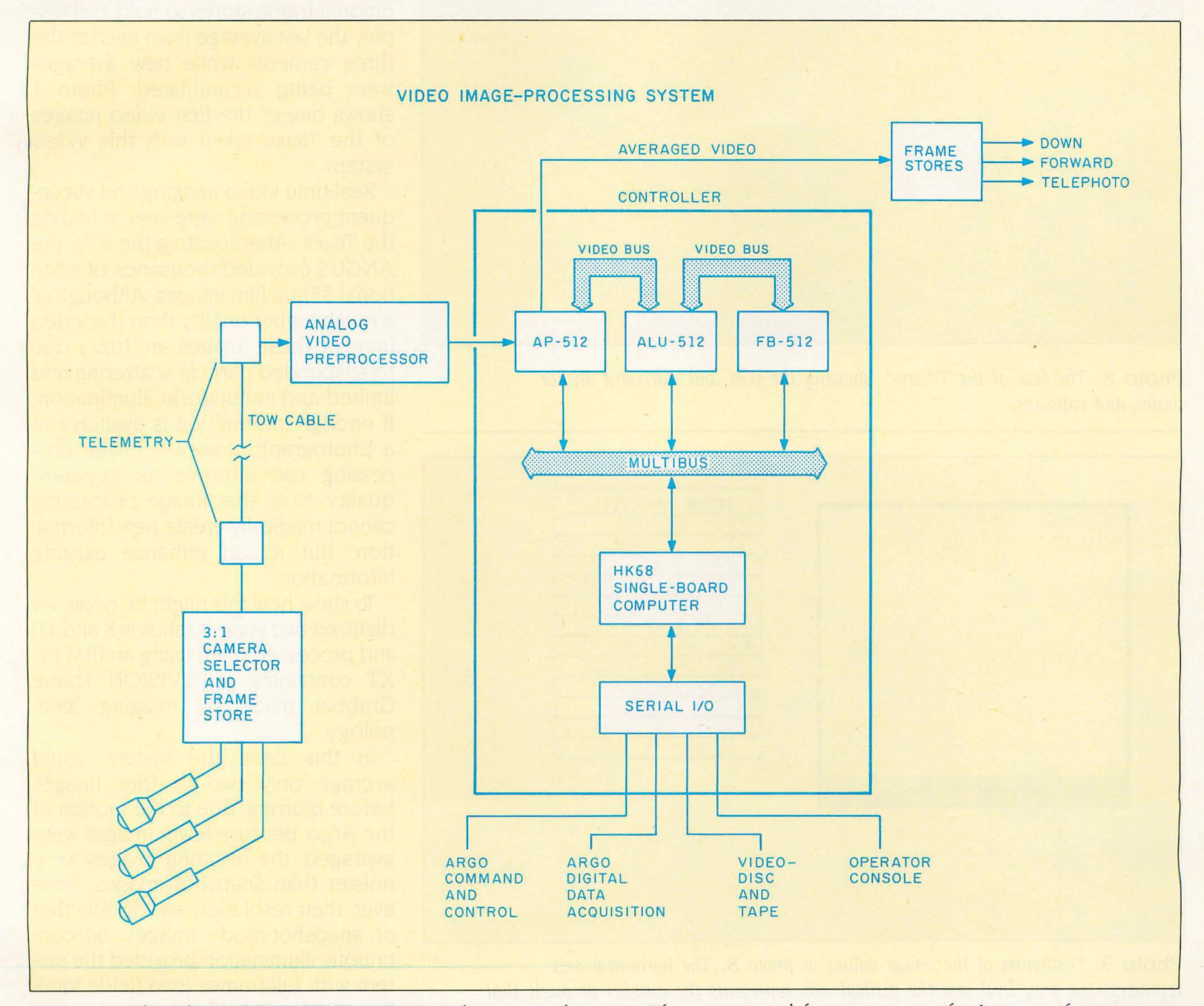


Figure 3: *The video image-processing system on the Argo and Knorr. The cameras and frame stores on the Argo are shown on the left and the processing and display hardware on the Knorr to the right.*

to the FB-512. Since a separate sum is kept for each of the more than 250,000 points (512 by 512 bytes) in the image and is updated 30 times per second, the ALU-512 performs over 7,000,000 sums, multiplies, and shifts (divisions) per second. A last pass through the ALU-512 divides the final sum to produce the average.

It should be noted that if the image changes, this averaging process results in a blurred image. The human eye performs a similar averaging, so that fast-moving objects appear blurred. To avoid this problem, the Argo sent the same stored image repeatedly while in snapshot mode and used fewer images while in continuous mode.

The illumination provided by the strobe light in snapshot mode was very brief. Because the SIT camera has a nonlinear signal decay, the video image transmitted was so degraded that only one field of information was used. Thus, in snapshot mode, the spatial resolution of the image was 240 by 512 pixels.

In both modes, the system used additional frame stores to hold and display the last average from each of the three cameras while new averages were being accumulated. Photo 1 shows one of the first video images of the *Titanic* taken with this video system.

Real-time video imaging and subsequent processing were keys to finding the *Titanic*. After locating the ship, the ANGUS provided thousands of additional 35mm film images. Although of a much higher quality than the video images, these images are fuzzy due to suspended particle scattering and limited and nonuniform illumination. If enough information is available in a photograph, however, image processing can improve its apparent quality. Note that image processing cannot magically create new information, but it can enhance existing information.

To show how this might be done, we digitized two images (photos 8 and 11) and processed them using an IBM PC XT containing a PCVISION Frame Grabber made by Imaging Technology.

In this case, the system could average only two to four images before blurring, due to the motion of the Argo. Because fewer images were averaged, the resulting images were noisier than snapshot images; however, their resolution was double that of snapshot-mode images, as continuous illumination provided the system with full frames (two fields totalling 480 by 512 pixels) for averaging rather than the single field (240 by 512 pixels) of snapshot mode.

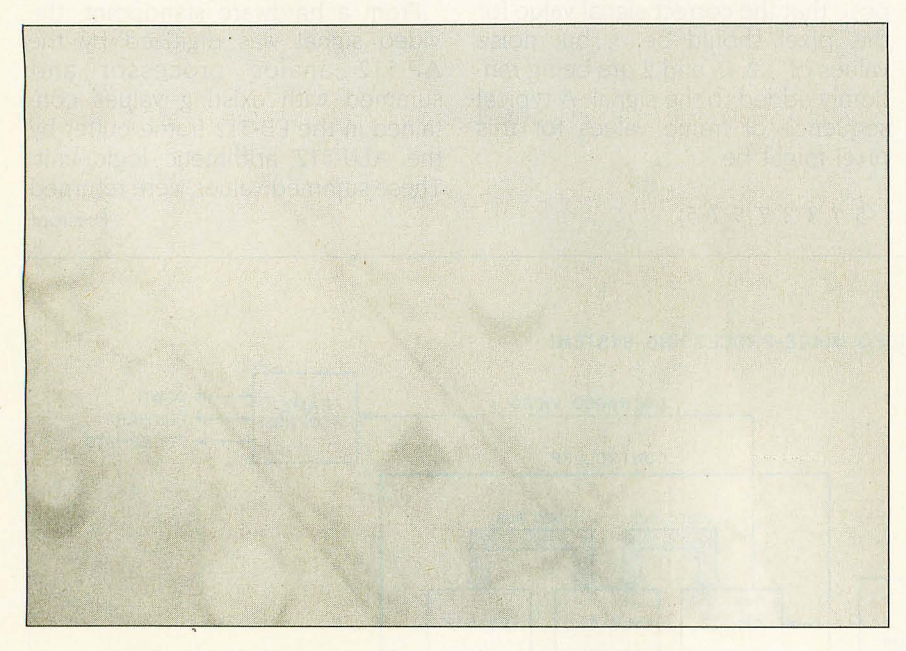


Photo 8: *The bow of the* Titanic, *showing the port and starboard anchor chains and capstans.*

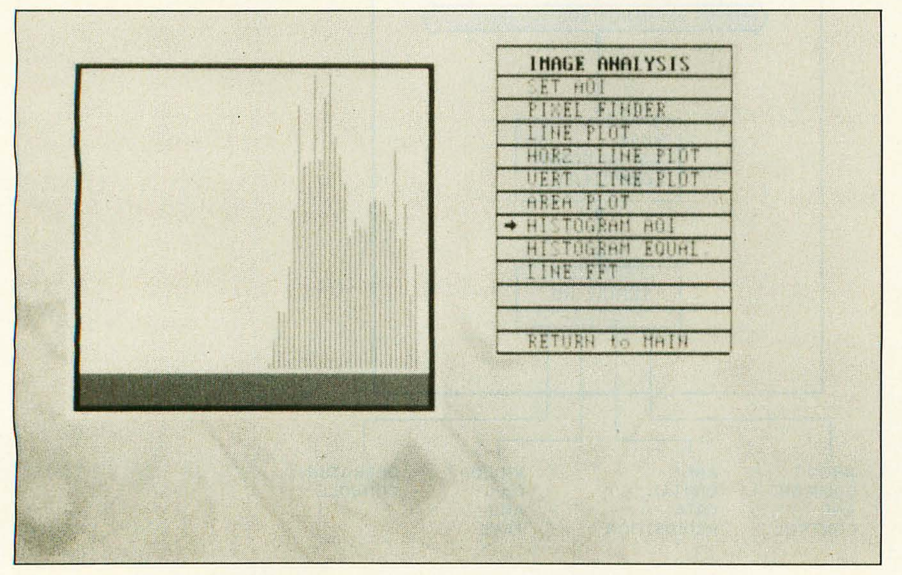


Photo 9: *Histogram of the image values in photo 8. The horizontal axis represents the gray level and the vertical axis represents the number of pixels that have that gray level. The menu shown is part of the Image Action software package made by Imaging Technology.*

CONTRAST ENHANCEMENT

One class of image-processing operations modifies the intensity values at each image point to enhance the apparent contrast of the image. Because these operations work only on a single image point, they are known as point processes. For example, if the intensity values in an image range from 0 to 100, the apparent contrast of the image may be increased by multiplying the value of each image point by 2.

The range of intensity values can be determined by a histogram operation, that is, by counting the number of pixels of each intensity. The histogram of photo 8, for example (photo 9), shows that the intensity values range from 130 to 255.

The contrast of this photo can be improved by transforming each pixel point by the following equation:

transformed pixel value =
  M * (original pixel value−K)

where K=130 and M=2.

This results in "sliding" the value of all pixels down the gray scale by 130, followed by a linear "stretch" of the values by 2.

In essence, this makes the lightest pixels white, the darkest pixels black, and linearly arranges the intermediate intensities to span the range of 0 to 255. This transformation can be done by lookup tables (LUTs) on the frame grabber. To understand the action of an LUT, consider that the LUT is a small block of memory that receives an 8-bit address as an input and outputs the 8-bit data stored at that address. The input addresses are pixel values and the values stored at these addresses are the transformed values that are output. Thus, rather than doing the transform on each and every pixel, the system checks the LUT to find the precalculated value. This saves time since, for example, every pixel with an intensity value of 200 will have a transformed value of 140.

Any arbitrary intensity transform can be generated and loaded into the LUT. We programmed the transform shown above into the LUT and the resulting enhancement and contrast of photo 8 is shown in photo 10.

EDGE ENHANCEMENT

Another class of image-processing operations uses the information from the area surrounding each pixel to change the spatial contrast of the image. When an area operation is used to sharpen or enhance the edges in an image, it is called an edge enhancement. Edge enhancements

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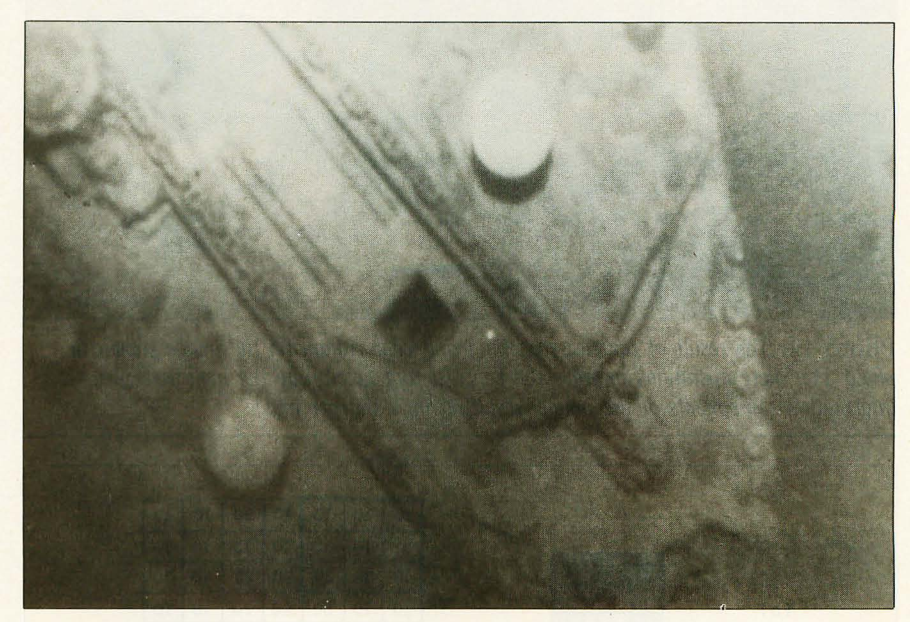


Photo 10: *The result of contrast-enhancing the image shown in photo 8. The process adds no new information to the image but adjusts the pixel values to improve the contrast.*

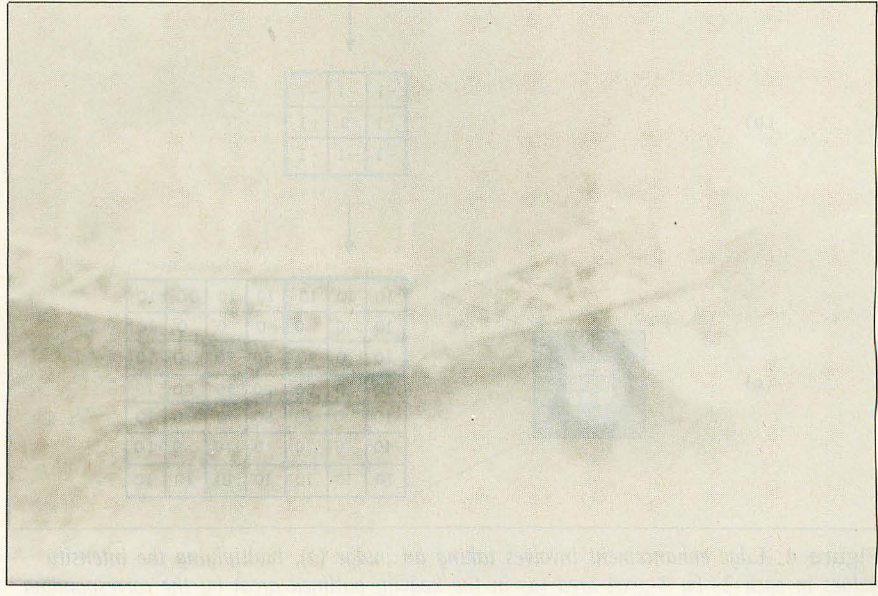


Photo 11: *Digitization of a photo taken by the ANGUS. This image shows the foredeck of the* Titanic *directly in front of the bridge, with the entire starboard crane, the boom of the port crane, part of the mast, and an open hold.*

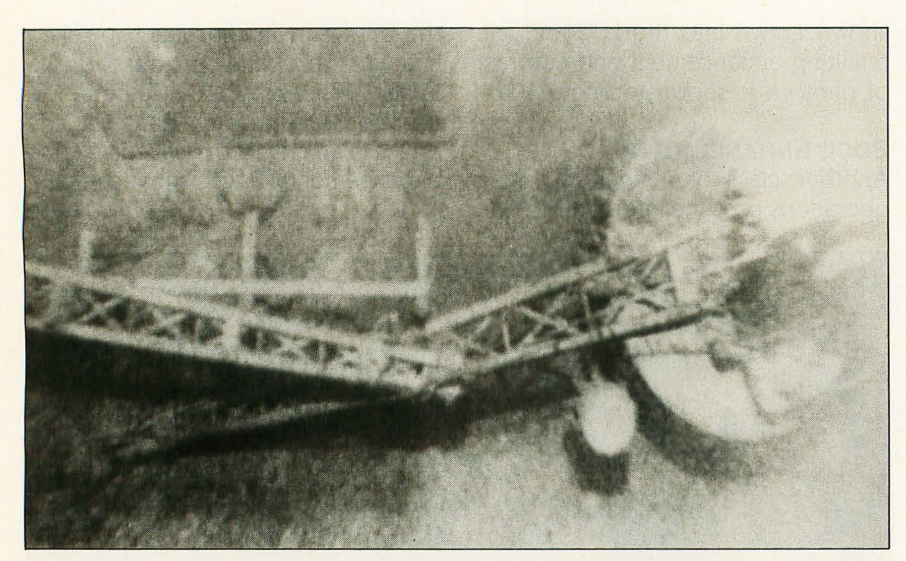


Photo 12: *The result of contrast-stretching and edge-enhancing the image shown in photo 11. These operations improve the contrast and accentuate the high-frequency information components of the image, resulting in a sharper image.*

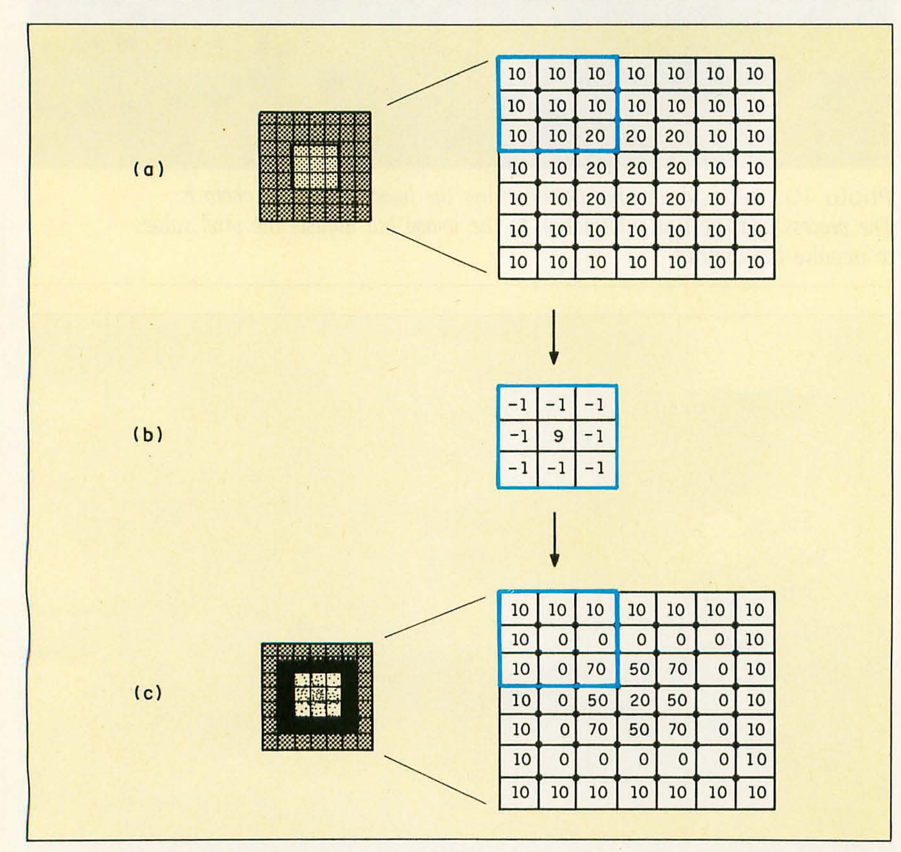


Figure 4: *Edge enhancement involves taking an image (a), multiplying the intensity values in each 3- by 3-pixel area (as in the heavily outlined area) by the corresponding values in a preset kernel (b), summing the products, and placing the results in the center pixel. The result of performing this process on (a) is shown in (c). Note how edge enhancement makes the dim inner square of (a) easier to view in (c).*

can use convolution to implement a spatial *filter* that accentuates high frequencies.

The convolution operation consists of multiplying pixels in the "neighborhood" of a given pixel by constants, summing and scaling, and replacing the center pixel by the result. The constants used for the multiplication are called the *kernel* of the convolution.

If the neighborhood is 3 pixels horizontally by 3 pixels vertically and the center pixel is at location (x,y), the convolutions operation can be represented by the following formula:

$$O(x,y)=M_1[I(x-1,y-1)]+M_2[I(x,y-1)]+M_3[I(x+1,y-1)]+M_4[I(x-1,y)]+M_5[I(x,y)]+M_6[I(x+1,y)]+M_7[I(x-1,y+1)]+M_8[I(x,y+1)]+M_9[I(x+1,y+1)]$$

You can extract the kernel values (M_1 to M_9) and represent them as a single table. For an edge enhancement, you can use the following kernel table:

$$\begin{matrix} -1 & -1 & -1 \\ -1 & 9 & -1 \\ -1 & -1 & -1 \end{matrix}$$

To see how this accentuates edges (changes) in an image, imagine one area of an image with intensity values as shown in figure 4a. If you overlay the kernel table (see figure 4b) on each 3- by 3-pixel section of the image, multiply the corresponding numbers, add all the products, and place the result in the center pixel, the resulting image is shown in figure 4c.

The effect of the convolution is to enhance spatial changes in intensity. In this example, the brighter square (with the original value of 20) is accentuated by decreasing the surrounding values to 0 and increasing the edge values to 70 at the corners and 50 in between. Note that areas that do not have any spatial change in intensity are left unchanged—the area surrounding the center square is still of intensity 10, and the center of the square is left at intensity 20.

Some of the resulting values of the convolution operator are negative numbers. Because negative intensity

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GLOSSARY

ARITHMETIC LOGIC UNIT (ALU): Hardware that performs arithmetic functions such as add or subtract and logical functions such as AND or OR.

DIGITIZE: The process of converting an analog (in this case, video) signal's amplitude to digital values.

DISPLAY: The device in which an image is converted from electrical to optical signals; typically, a television monitor.

FIELD: In an interlaced scanning system, the set of even or odd lines into which a frame is divided.

FILTER: In image processing, an operation that changes the spatial and intensity characteristics of an image.

FRAME: The total number of lines of scan that represent an image.

FRAME BUFFER: A high-speed memory designed to store a single image and allow simultaneous video display, ALU processing, and CPU (central processing unit) access.

FRAME MEMORY: Any area in memory (host-computer memory or frame-buffer memory) that is used to store an image.

FRAME STORE: A high-speed memory designed to temporarily store a single image.

IMAGE PROCESSING: The alteration and analysis of a picture for such purposes as enhancement and recognition.

INTENSITY: The strength of light at a particular point in an image. Pixels represent intensity values that are perceived by the eye as brightness.

INTERLACE: The means by which an image is scanned in standard video format, where the odd and even fields are displayed alternately.

LOOKUP TABLE (LUT): Hardware that provides map values for transforming or modifying pixels. Each pixel in the frame buffer has a value ranging from 0 to 255. LUTs allow you to modify these values for purposes of enhancing the image.

PIXEL: The smallest unit of storage in a digital image, addressed by that unit's horizontal and vertical coordinate or location within an image.

REAL TIME: In image processing, an operation or a function that is completed in one frame time is said to be performed in real time. For standard television (RS-170) equipment, a frame time is 1/30 of a second.

RESOLUTION: In image processing, the number of bits of accuracy or number of gray levels that can be represented in a pixel; for example, 8 bits = 256 levels, 6 bits = 64 levels.

SPATIAL RESOLUTION: In image processing, the number of pixels into which an image is divided, indicating the precision or accuracy horizontally and vertically. For example, a spatial resolution of 480 by 512 pixels means that the image has 480 lines, with 512 pixels each (for a total of 245,760 pixels).

is meaningless, we have changed these values to 0.

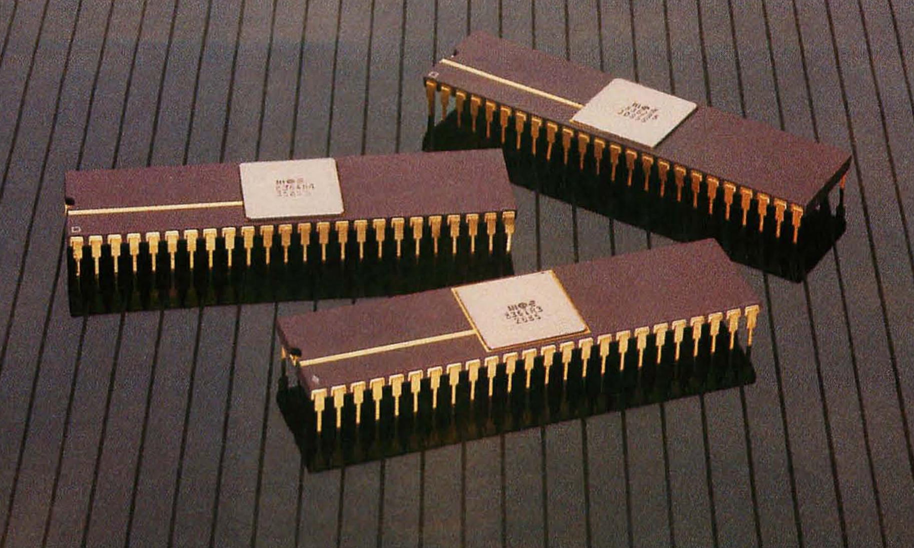
The image shown in photo 11, two cranes on the foredeck of the *Titanic*, was enhanced using the LUTs and convolved with an edge-enhancing kernel (see photo 12).

CONCLUSION

Deep-sea exploration is just one of the many applications in which image processing is being used. For example, image processing is used in medical imaging for digital radiography, microscopy, X-ray averaging and recording, and in factory inspection for robotic vision, quality control on production lines, and X-ray inspection. Finding the *Titanic* is certainly a spectacular example of the processes that scientists and technicians in a variety of fields are using to coax useful information from two-dimensional images. ■

ACKNOWLEDGMENT

We thank Robert Squires and Stewart Harris of the Woods Hole Institution Deep Submergence Laboratory for information and assistance in preparing this article. Bob and Stu are part of a team of scientists and engineers on the Titanic *expedition and under the direction of* Dr. Robert Ballard, *who designed and built the Argo.*



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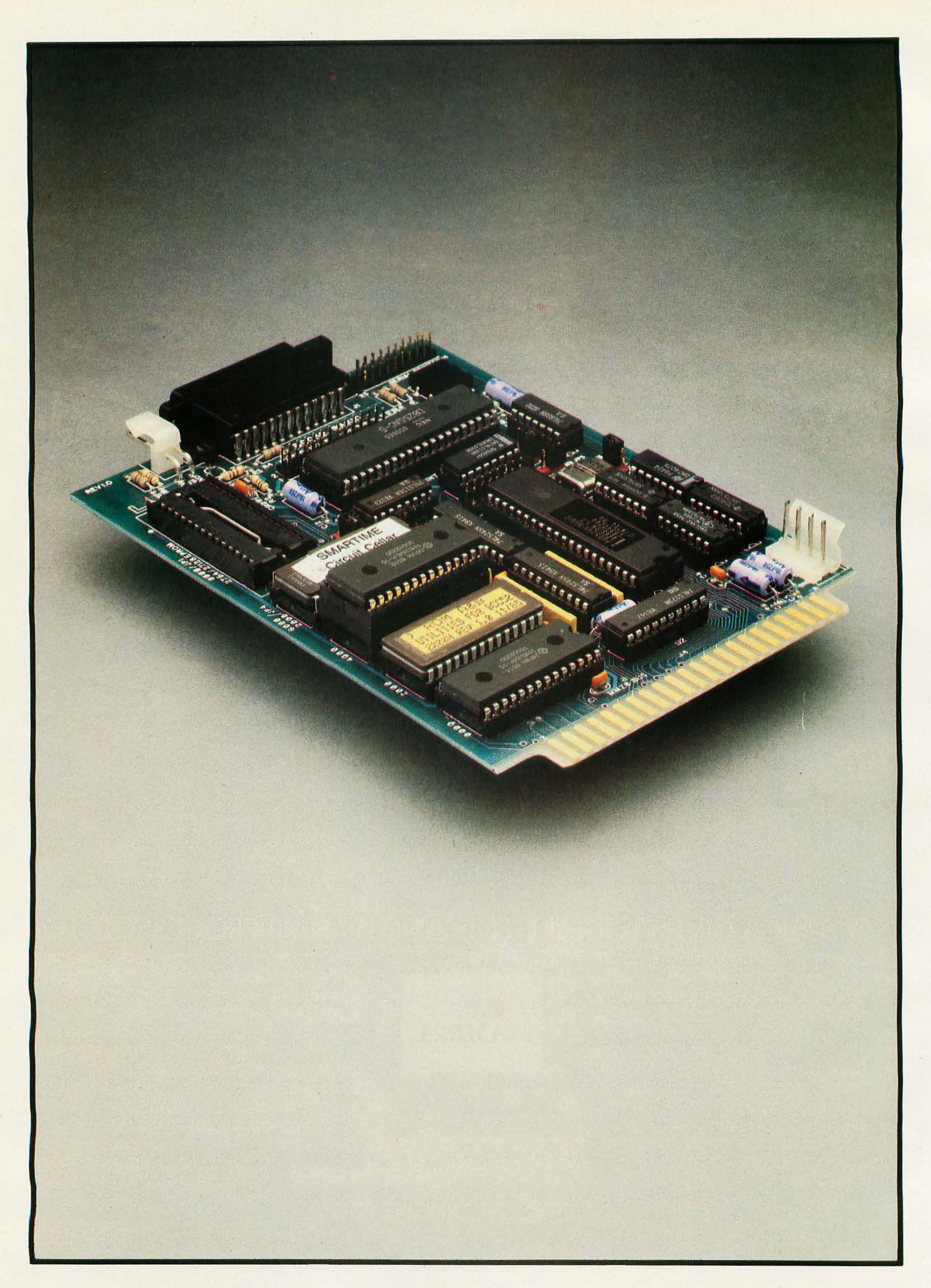


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REAL-TIME CLOCKS: A VIEW TOWARD THE FUTURE

BY STEVE CIARCIA

One of these clocks also provides nonvolatile RAM

Ever have one of those occasions when everything is progressing smoothly and then you hit a big snag? Here I was, standing on a 6-foot ladder with screwdrivers in my back pockets, electric drill in my right hand, hammer in my belt, mouth full of screws, a pencil over my ear, and the audio/video multiplexer that I described last month balanced in my left hand. A precarious climb if ever there was one, I assure you.

I had solved the ever-present do-it-yourself problem of forgetting some needed tool by dragging everything along with me up the ladder. I cursed as I banged my head on an overhead heating duct and swore that the next time I set aside an area to mount all this home-control junk, I'd know everything I was going to put on it in advance and leave plenty of room. Instead of a convenient shoulder-high location where life would be easy, I was halfway up under the floor joists sniffing concrete dust and soot. (Installing this stuff is getting about as pleasurable as writing software for me these days. Back when all I had was 48-instruction processors and lots of empty wall space, everything was copacetic.)

The only saving grace to this temporary agony was that it would soon be relieved by the enhanced automatic living afforded through the intelligent audio/video multiplexer (AVMUX). Using the BCC-52 computer and a smart terminal board from a couple of previous Circuit Cellar projects, the AVMUX would take inputs from a variety of audio and video sources and channel them to any of a number of specific outputs. My intention was to enhance my present level of automatic living to include programmed light, sound, and music.

I wiped my brow after turning the last mounting screw for the AVMUX and instinctively dodged another floor joist as I looked down at the card cage containing the computer that I still had to mount. I had included all the necessary cabling and mounting hardware between it, the multiplexer, and the Home Run Control System (HCS) already in operation. My control program was already written and saved in EPROM (erasable programmable read-only memory) so that it would automatically start when I powered up the system. Depending upon the day, time, direct signals from the HCS, and a yet-to-be-designed remote-

(continued)

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control interface, specific or dynamically variable I/O (input/output) configurations would be mapped into the AVMUX. By retaining the different I/O maps in RAM (random-access read/write memory), the controller could switch among different command situations easily and rapidly.

Time? Memory maps? Uh-oh. It's terrible getting revelations on a ladder. Instead of the normal reaction—stand up, slam my hand on the desk, and yell "That's it!"—I had to be cognizant of the limited headroom and the dust I would raise by yelling.

In actuality, I had discovered nothing—nothing except a realization that what I had remembered was what I had forgotten to incorporate in my controller design. While the BCC-52 had a real-time clock/calendar within BASIC, it lacked the capability of retaining the I/O maps in RAM or the time if a power failure occurred.

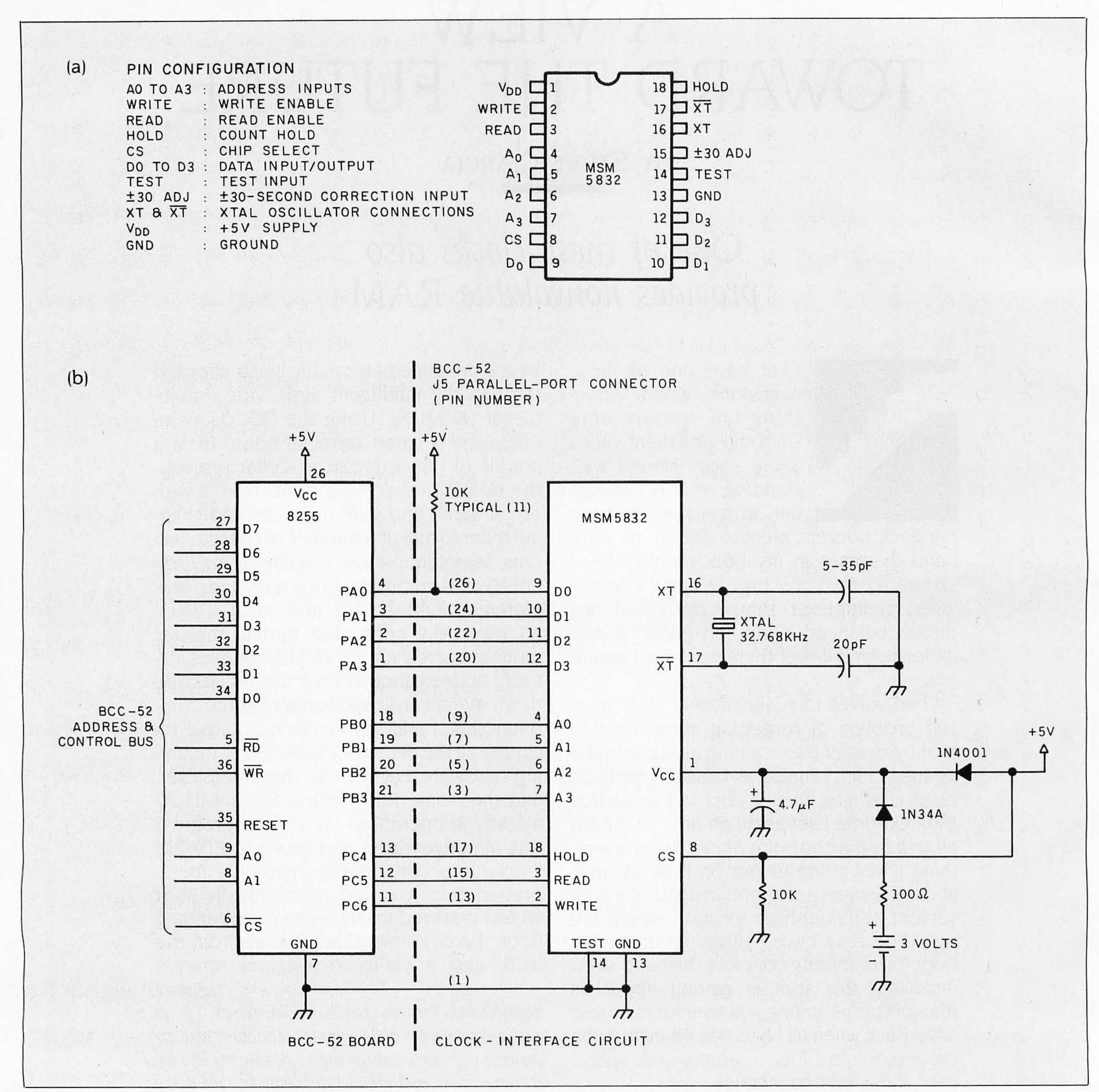


Figure 1: *(a) Pin-out of the Oki MSM5832 clock chip. (b) Schematic diagram of a real-time clock circuit using the chip from (a) and an 8255 PIA (already on the BCC-52).*

The EPROM-resident control program was self-initiating and would not be destroyed. But it would start up with a time and date of zero and RAM cleared.

My first reaction was to consider a UPS (uninterruptible power supply) or backup battery power for the whole computer. Either option was expensive and would consume a lot of circuit-board real estate that I didn't have. Even if successful, what good is powering the whole computer system unless all the peripherals that it controls are operational as well? In reality, all I needed to power was less than 1K byte of RAM and whatever component or system functions as the real-time clock/calendar. Of course, powering the whole computer would indeed provide nonvolatile memory and an uninterruptible clock/calendar.

Another trek up this ladder to mount a half-dozen rechargeable batteries didn't appeal to me. I needed a self-contained, battery-backed real-time clock that operated independently of the BCC-52 yet could be interrogated periodically regarding the time. Along the way, I'd look into making some portion of RAM nonvolatile.

Within seconds, I was down the ladder and shuffling through my junk box: piles of unopened news releases and an eyebrow-high pile of trade publications. The dimensions of this pile are usually affected only by an earthquake or a desperate search for some new technical idea around article time. Fortunately, my search was rewarded, and I came upon two solutions. One of them uses conventional technology; the other one is rather innovative.

This month, I'll describe two real-time clock/calendars and let you be the judge of which one you want to implement in your application. While both circuits are applicable to any computer, I was specifically looking to attach a clock and nonvolatile RAM to the BCC-52. Also, since I have covered the basics of real-time clocks and the specific attributes of the BCC-52 computer in previous Circuit Cellar articles, I refer you to them for additional information: "Everyone Can Know the Real Time" (May 1982, page 34) and "Build the BASIC-52 Computer/Controller" (August 1985, page 104).

The first device uses a CMOS (complementary metal-oxide semiconductor) clock/calendar chip that attaches to the computer through parallel ports. Easy to exercise in software but consumptive of I/O, this conventional approach appeals to many of us who simply want a quick resolution of a problem and are not concerned about the I/O costs or having to manufacture thousands of them. The

(continued)

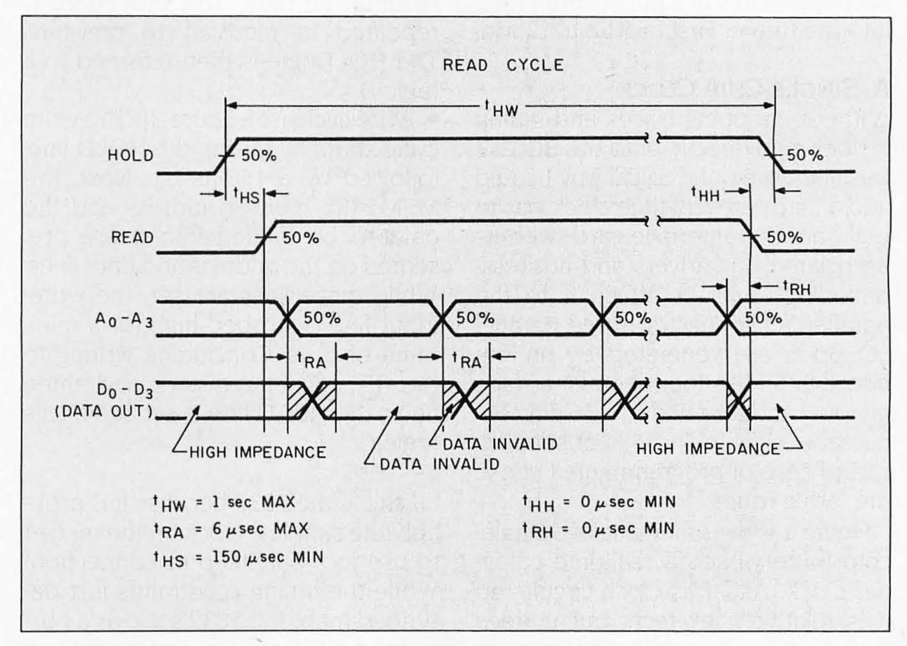


Figure 2: *The read-cycle timing diagram for the* MSM5832.

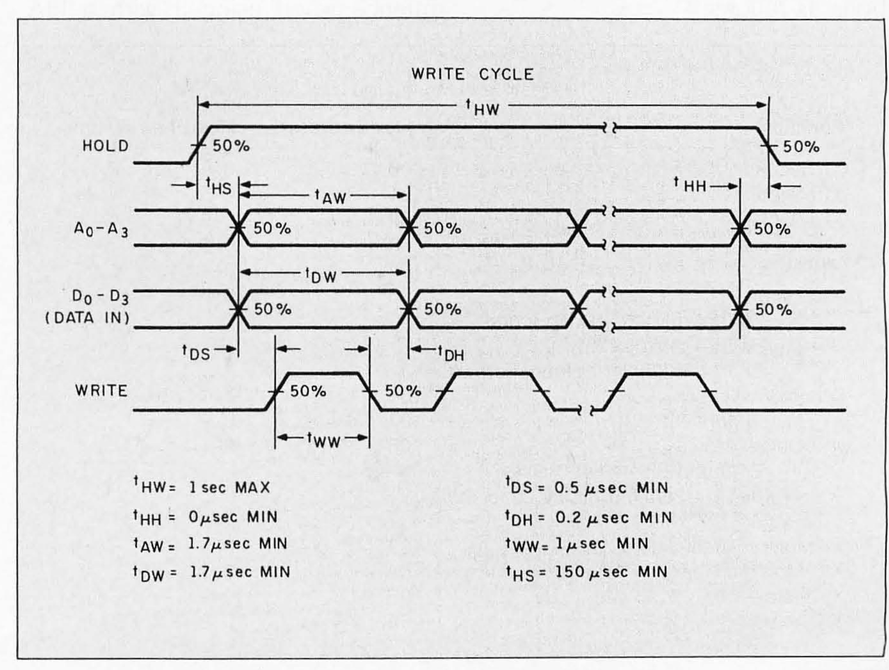


Figure 3: *The write-cycle timing diagram for the* MSM5832.

second approach uses a new clock "socket" from Dallas Semiconductor that requires no independent interfacing and merely plugs in with a static-RAM chip that might already be resident in the computer system. While software-intensive compared to the conventional clock chips, the concept is unique and will surely prevail long into the future. First, a little tradition.

A Single-Chip Clock

Without chopping traces and gluing a clock chip directly onto the BCC-52 bus lines, the only logical way I could add a hardware real-time clock was to build another interface card (with its associated bus drivers and address-decoding logic) or attach it to the parallel I/O connector (three parallel I/O ports are generated by an onboard 8255 PIA [peripheral interface adapter] and attached to a 26-pin connector designated as J5). For simplicity and ease of programming, I chose the latter route.

Figure 1 is the schematic of a single-chip battery-backed real-time calendar clock. As far as clock circuits go it is relatively low-tech, but it does work and was easy to build. It uses an Oki MSM5832 clock chip that functions as follows:

- Read cycle (see figure 2): The HOLD line goes high first, followed by the 150-microsecond hold setup time (t_{HS}). After this, READ is set high, and the specific MSM5832 registers are sequentially (or randomly) addressed. There is a 6-μs read-access time delay (t_{RA}) between setting the address and reading the data. This procedure is repeated to read all 16 registers. The HOLD line is then returned to a logic 0.
- Write cycle (see figure 3): The write cycle starts by raising the HOLD line, followed by a 150-μs t_{HS}. Next, the MSM5832 register address and the data to be loaded into it are presented on the address and data lines. While these lines are set, the write-input line is strobed high for a minimum of 6 μs. Concluding writing to the 13 counter/registers and three flags, the HOLD line is set again to a logic 0.

I chose the 5832 because it is probably the simplest clock on the market to use in a parallel-port connection. While the timing constraints just described make the 5832's use as a bus-connected clock chip a more difficult connection, they are of little consequence when using it with a PIA, especially one operated in BASIC. Many clock chips are available to match the speeds of today's processors. By connecting them through a PIA, however, this increased speed is filtered by the PIA and is of no extra value. Specific bits on the PIA function to simulate the computer bus, but the range of control is greater, and bus timing constraints are eliminated.

The 5832 functions by counting pulses from a 32-kilohertz crystal. These counters can be individually preset (setting the time) or read (reading the time) under program control. The chip is CMOS, and while it operates on 5 volts, it retains its status and continues keeping time with a power supply of only 2.2 V. Two hearing-aid batteries (1.5-V alkaline) are soldered together to produce 3 V. (While lithium batteries are preferred, all the lithium batteries I had were larger than I cared to use on this clock.) When the computer is powered, 5 V is applied to V_{CC} and the clock chip-select line, enabling all I/O and programming functions. With the absence of power, the chip continues to function on 2.8 V supplied through a germanium diode, but I/O and programming functions are inhibited because the chip-select line will be at logic 0.

Five volts is not normally available on the J5 parallel I/O connector, so I had to add a jumper to the back of the board. Rather than try to reroute the circuit connections of J5, I wired +5 V to pin 10 of the J2 serial-printer header and attached a jumper wire with a 2-pin header to connect this power to the prototype board. This pin is not normally used on a serial printer and will not obstruct its use. If you want both the real-time clock and a printer to function together, however, you'll have to make an alternate connection point.

The entire clock is constructed on a 3-square-inch piece of prototyping board that piggybacks on the BCC-52 and plugs directly into the J5 parallel-port connector. Four bits of port A (on the 8255) function as the clock chip's bidirectional data bus; 4 bits of port B serve as the address bus. Three ad-

Function	MSM5832 Hex Address	Hex Entry Range
X1 Seconds	00	0–9
X10 Seconds	01	0–5
X1 Minutes	02	0–9
X10 Minutes	03	0–5
X1 Hours	04	0–4
X10 Hours	05	0–11
Bit 0 and Bit 1 — X10 Hours		
Bit 3 — AM(0)/PM)1)		
Bit 4 — 12(0)/24(1) Hours Format		
Day of Week	06	1–7
X1 Day of Month	07	0–9
X10 Day of Month	08	0–7
Bit 0 and Bit 1 — X10 Days		
Bit 2 — 28(0)/29(1) Day Leap Year		
Bit 3 — N/C		
X1 Month of Year	09	0–9
X10 Month of Year	0A	0–1
X1 Years	0B	0–9
X10 Years	0C	0–9

Figure 4: *A map of the MSM5832's registers.*

ditional bits of port C provide control signals that gate data into and out of the clock chip. The addresses and functions of these clock registers are shown in figure 4.

As listing 1 demonstrates, the 5832 is easy to set and read in BASIC. To set the time, the three ports are all configured as outputs by loading 80 hexadecimal into the 8255's control register (P4). Since I was writing the program (and you know how I feel about programming), I didn't get too fancy with PRINT statements in the clock-setting routines. Considering that the clock should have to be set only once forever, I think you can do a little hand calculation on the bit configurations and enter each of the presets with a simple prompt of which register is being loaded. If it's August 8th, for example, I expect that you could translate that into an 8 for register 9 and a 0 for register 10. As each entry is made, the port C (P3) control lines are activated in this sequence—hold on, write on, write off, hold off—thus functioning as a simple write strobe.

Reading the device is much simpler. Port A is set as input; ports B and C are set as outputs by loading 20 hexadecimal into the 8255's control register. The 13 clock registers are read by sequentially setting an address on port B and storing the value presented to port A. Because we are doing this all in BASIC, timing is noncritical. Even the hold command, normally enabled whenever the 5832 is read or set, can be ignored if counter-update ripple-through is not critical. After reading all the registers, the values are multiplied by the appropriate constants and added. My software is bare bones, and 24-hour timing was chosen for simplicity. (I realize I could have done it with 11 bits on only two ports—and probably never have finished the software.)

Listing 1: A BASIC *program to set and read the* MSM5832 *real-time clock chip.*

```
100    DIM N(200) :  DIM M(200)
110    REM
120    REM    REV 1.5 11/8/85
130    REM  5832 REAL TIME CLOCK FOR BCC-52 I/O PORT
140    REM
150   P1=51200 : P2=51201 : P3=51202 : P4=51203
155    REM SET 8255 PORT A AS INPUT AND B&C AS OUTPUT
160   XBY(P4)=90H
170    REM    PORT B IS ADDRESS AND PORT C IS CONTROL BUS
180    PRINT "ENTER 0 TO SET TIME OR 1 TO READ TIME",
       : INPUT A
190    ON A GOSUB 350,220
200    GOTO 180
210    GOTO 145
220    REM    READ 13 5832 REGISTERS
230   XBY(P3)=20H :  REM      SET READ MODE
240    FOR A=0 TO 12
250   XBY(P2)=A : N(A)=XBY(P1)
260    NEXT A
270    REM  DISPLAY CONTENTS
280    PRINT "DATE ",
290    PRINT N(10)*10+N(9),"/",N(8)*10+N(7),"/",N(12)
       *10+N(11)
300    PRINT "TIME ",
310    IF N(5)>=8 THEN N(5)=N(5)-8
320    PRINT (N(5)*10)+N(4),"  :  ",(N(3)*10)+N(2),"  :  ",
       (N(1)*10)+N(0)
330    PRINT
340    RETURN
350    REM SET TIME
360   XBY(P4)=80H :  REM   SET PORTS A,B,&C AS OUTPUT
370    REM MSB OF REG 5 12(0)/24(1) HRS & MSB-1 AM(0)/PM(1)
380    FOR A=0 TO 12
390    PRINT "REGISTER",A, :  INPUT X
400   XBY(P2)=A : XBY(P1)=X
405    REM WRITE STROBE
410   XBY(P3)=10H : XBY(P3)=50H : XBY(P3)=10H : XBY(P3)=00H
420    NEXT A
430   XBY(P4)=90H :  REM    RESTORE READ PORT SETTINGS
440    PRINT
450    RETURN
```

A Real-Time Clock with No Interface Required

As I wrote the above subhead, I tried to imagine how you would interpret it. Would the skeptical among you say, "Who's he trying to kid?" Or would you take it on faith that I've had the answer up my sleeve all along?

While the previous circuit works very well, and many of you no doubt will build it, it is I/O-intensive. The value of a single-board computer like the BCC-52 is that it is often desirable to implement it as a single-board control solution. As such, the parallel ports might be needed for the application and not be available for the clock interface I've described.

Not using the PIA means that the clock chip must be connected to the bus and addressed as memory or additional I/O. Short of using one of the already-decoded 8K-byte memory-block address strobes and building the clock to plug it in in place of a memory chip, it would appear that the only alternative is to attach the clock circuit through the external expansion-bus connector. That, however, would be the traditional answer to the problem.

Using one of the RAM-chip locations sounds like the most logical approach, until you realize that you are sacrificing 25 percent of the available on-board RAM (the BCC-52 holds 32K bytes of RAM in four 8K-byte chips on board) for less than 10 bytes of clock data. It would be much better if both

(continued)

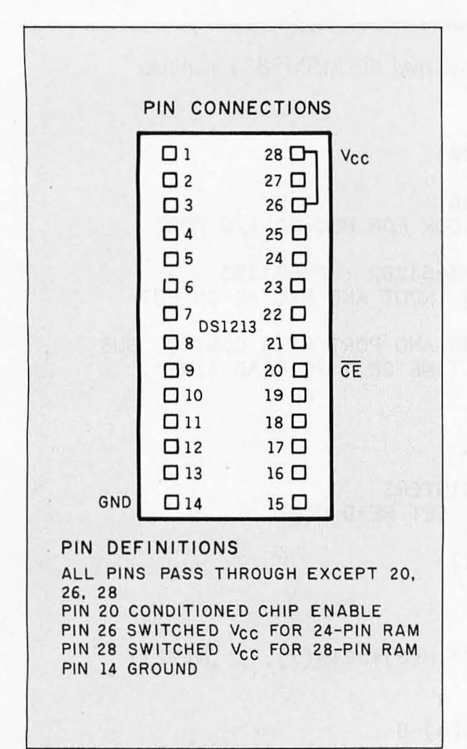


Figure 5: A *pin-out diagram of the SmartSocket.*

the clock and the RAM could share the memory-block address and any locations not those of the clock could be RAM. Better yet, why not keep all the RAM and attach the clock as a phantom interface that is there only when you need it?

Just as I was cleaning off the soldering iron to build the ultimate real-time clock, I discovered that such a device was just introduced by Dallas Semiconductor (4350 Beltwood Parkway South, Dallas, TX 75244, (214) 450-0470). Called SmartWatch, it does everything I had hoped in a single package and has some startling side benefits, like 8K bytes of nonvolatile memory. This latter revelation necessitates starting at the beginning and discussing a few additional Dallas Semiconductor products that are incorporated in the SmartWatch. The most notable of these is the DS1213 SmartSocket.

NONVOLATILE RAM

The DS1213 is a 28-pin 0.6-inch-wide DIP (dual in-line package) socket with a built-in CMOS controller circuit and lithium battery (see figure 5). It accepts either a 28-pin 8K by 8 or 24-pin 2K by 8 lower-justified JEDEC (Joint Electronic Device Engineering Council) byte-wide CMOS static RAM. When the socket is mated with a CMOS RAM, it makes the RAM contents nonvolatile by automatically switching the RAM to battery operation and write-protecting it upon any occurrence of power interruption.

The SmartSocket performs five circuit functions necessary for implementing battery backup on a CMOS memory. First, a switch is provided to direct power from the battery or V_{CC} supply, depending on which is greater. This switch has a voltage drop of less than 0.2 V. The second function is power-fail detection at input voltages less than 4.75 V. The DS1213 constantly monitors the V_{CC} supply. When V_{CC} falls below 4.75 V, a precision comparator detects the condition and inhibits enabling of the RAM chip.

The third function accomplishes write protection by holding the chip-

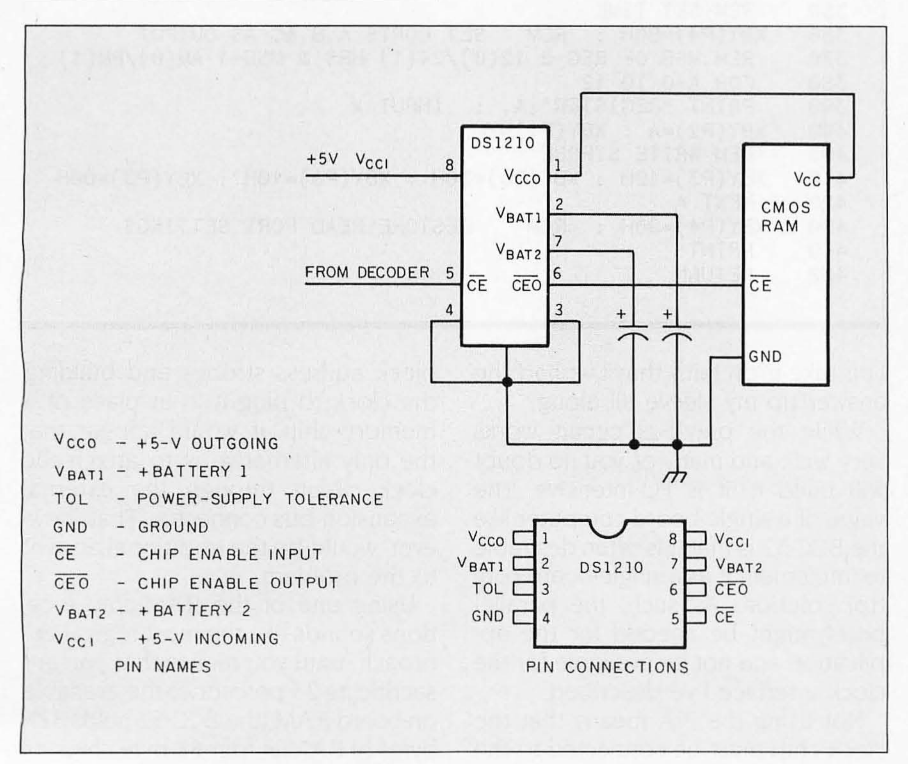


Figure 6: *The pin-out and functional diagram for the* DS1210 *nonvolatile-*RAM *controller.*

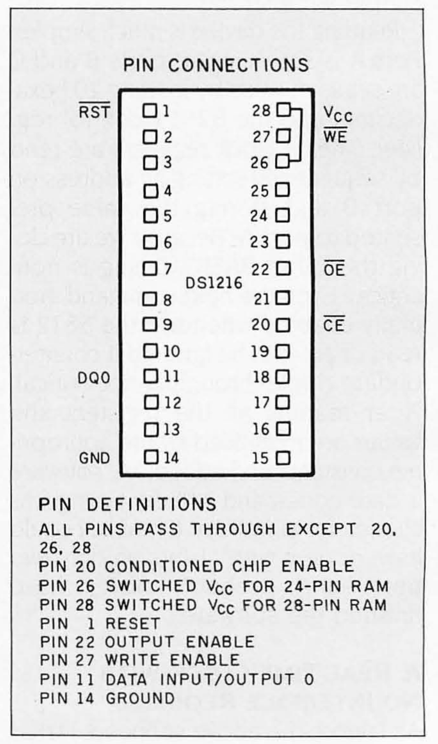


Figure 7: A *pin-out for the* DS1216 *SmartWatch.*

enable signal to the memory to within 0.2 V of V_{CC} or battery supply. If the chip-enable signal is active at the time power-fail detection occurs, write protection is delayed until after the memory cycle is complete to avoid corruption of data. During nominal power-supply conditions, the memory chip-enable signal will be passed through to the socket receptacle with a maximum propagation delay of 20 nanoseconds.

The SmartSocket's fourth function is to check battery status and warn of potential data loss. Each time that V_{CC} power is restored to the SmartSocket, the battery voltage is checked with a precision comparator. If the battery supply is less than 2.0 V, the second memory cycle is inhibited. Battery status can, therefore, be determined by performing a read cycle after power-up to any location in the memory, recording the contents of that memory location. A subsequent write cycle can then be executed to the same memory location, altering the data. If the next read cycle fails to verify the written data, the contents of the memory are questionable because the battery may not have retained it.

The fifth function is battery redundancy. In many applications, data integrity is paramount. The DS1213 SmartSocket has two internal batteries. During battery-backup time, the battery with the highest voltage is selected for use. If one battery fails, the other automatically takes over. The switch between batteries is transparent to the user. A battery status warning occurs only if both batteries are less than 2.0 V. Each of the two lithium cells contains 35 milliampere/hour capacity, making the total 70 mA/hr.

If you are contemplating a new design and want the benefits of nonvolatile static memory, the essential ingredients of the SmartSocket are available in chip form. Designated as DS1210, DS1224, and DS1212, they coordinate and perform the above described backup and write-protect functions for banks of 1, 4, or 16 in-

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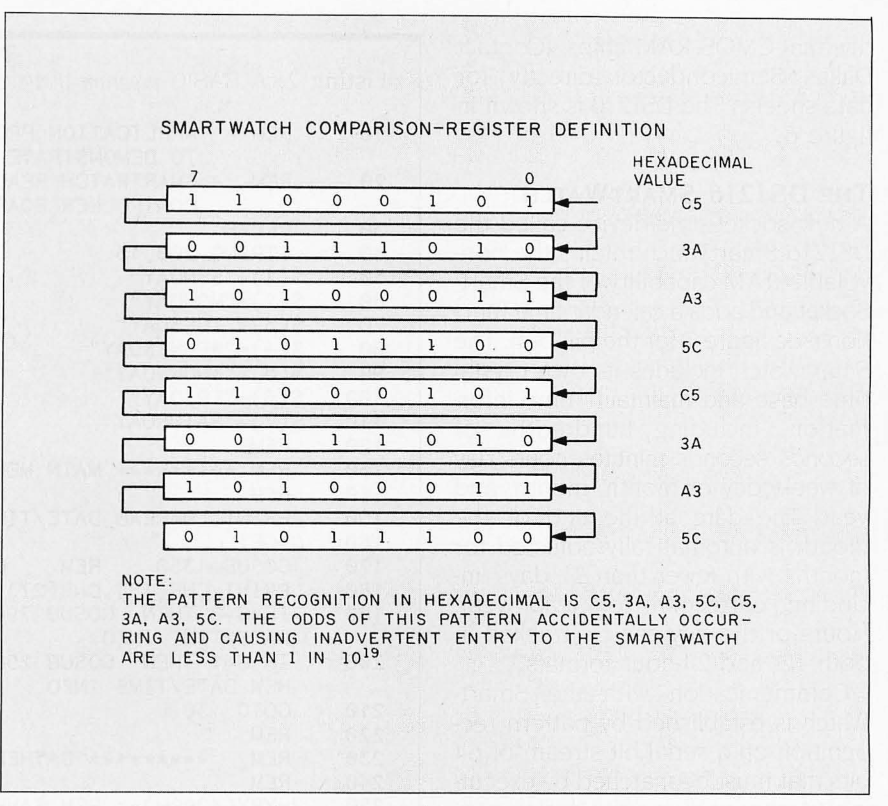


Figure 8: *The SmartWatch's comparison bit pattern.*

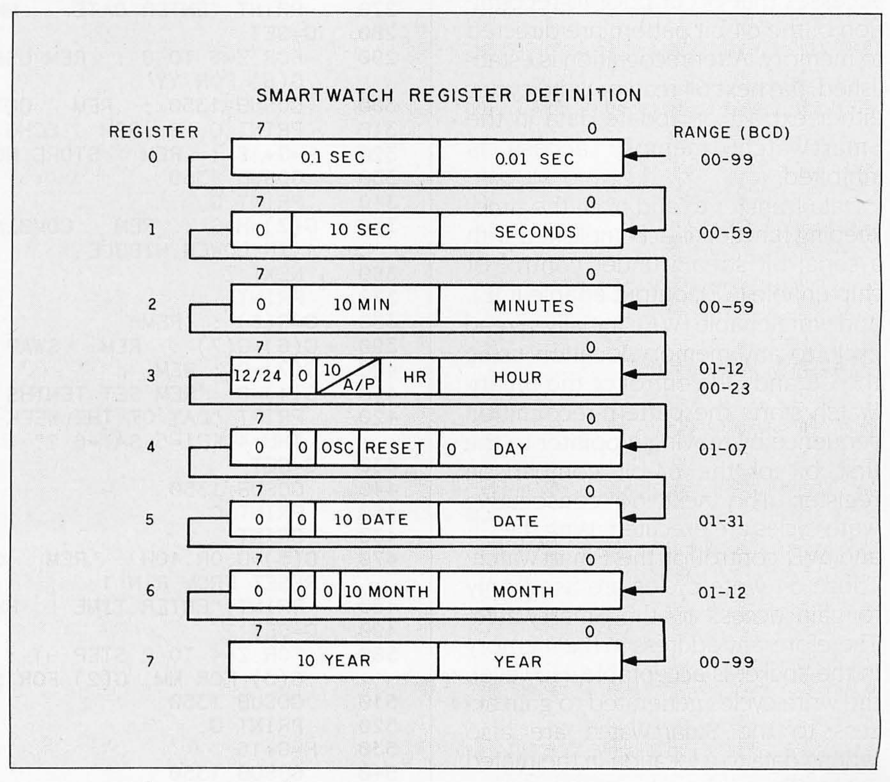


Figure 9: *The SmartWatch's registers.*

dividual CMOS RAM chips. (Contact Dallas Semiconductor directly for data sheets.) The DS1210 is shown in figure 6.

THE DS1216 SMARTWATCH

A new socket-style device called the DS1216 SmartWatch retains the nonvolatile-RAM capability of the SmartSocket and adds a calendar time function (see figure 7 for the pin-out). The SmartWatch includes its own crystal time base and maintains time information, including hundredths of seconds, seconds, minutes, hours, day of week, day of month, month, and year. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including correction for leap year. Hours of the day can be tracked in both 12- and 24-hour formats.

Communication with the SmartWatch is established by pattern recognition on a serial bit stream of 64 bits that must be matched by executing 64 consecutive write cycles containing the proper data on DQ0. All accesses that occur prior to recognition of the 64-bit pattern are directed to memory. After recognition is established, the next 64 read or write cycles either extract or update data in the SmartWatch; memory access is inhibited.

Data transfer to and from the timekeeping function is accomplished with a serial bit stream under control of chip enable ($\overline{CE}$), output enable ($\overline{OE}$), and write enable ($\overline{WE}$). Initially, a read cycle to any memory location using the $\overline{CE}$ and $\overline{OE}$ control of the SmartWatch starts the pattern-recognition sequence by moving a pointer to the first bit of the 64-bit comparison register. The next 64 consecutive write cycles are executed using the $\overline{CE}$ and $\overline{WE}$ control of the SmartWatch. These 64 write cycles are used only to gain access to the SmartWatch. Therefore, any address to the memory in the socket is acceptable. However, the write cycles generated to gain access to the SmartWatch are also writing data to a location in the mated RAM. The preferred way to manage this requirement is to set aside one

Listing 2: A BASIC *program that sets and reads the SmartWatch.*

```
10    REM    APPLICATION PROGRAM USING ONLY BASIC
             TO DEMONSTRATE
20    REM    SMARTWATCH REAL TIME CLOCK ON BCC52 COMPUTER
             CONTROLLER BOARD
30    CLEAR
40    STRING 200,15
50    $(1)="SUNDAY"
60    $(2)="MONDAY"
70    $(3)="TUESDAY"
80    $(4)="WEDNESDAY"
90    $(5)="THURSDAY"
100   $(6)="FRIDAY"
110   $(7)="SATURDAY"
120   REM
130   REM ********* MAIN MENU ********
140   REM
150   PRINT "0=READ DATE/TIME   1=ENTER NEW DATE/TIME ?"
160   G=GET
170   GOSUB 1350 :  REM   GET NUMBER 0-9
180   PRINT CHR(18),CHR(27),"Y" : REM CLR & HOME TERMITE
190   IF G=0 THEN  GOSUB 790 : REM READ & DISPLAY
      DATE/TIME INFO
200   IF G=1 THEN  GOSUB 250 : REM GATHER & SAVE
      NEW DATE/TIME INFO
210   GOTO 150
220   REM
230   REM    ********* GATHER $ SAVE NEW DATE/TIME INFO
240   REM
250   J=XBY(4000H) : REM SAVE BYTE LOCATED IN 4000H
      TO REPLACE WHEN DONE
260   GOSUB 1420 : REM SEND PATTERN RECOGNITION CODES
270   PRINT "ENTER DATE     MMDDYY"
280   G=GET
290   FOR Z=6 TO 8 :  REM USE G(6) FOR MM, G(7) FOR DD,
      G(8) FOR YY
300   GOSUB 1350 :  REM   GET NUMBER 0-9
310   PRINT G, :  REM   ECHO NUMBER 0-9
320   H=G*16 :  REM   STORE NUMBER IN UPPER NIBBLE
330   GOSUB 1350
340   PRINT G,
350   G(Z)=H+G :  REM   COMBINE NUMBERS 1 IN UPPER NIBBLE,
      1 IN LOWER NIBBLE
360   NEXT Z
370   PRINT
380   G=G(6) :  REM
390   G(6)=G(7) :  REM   SWAP 6 & 7, NOW 6,7,8 IN DD/MM/YY
400   G(7)=G : REM
410   G(1)=0 : REM SET TENTHS & HUNDREDTHS OF A SECOND = 0
420   PRINT "DAY OF THE WEEK SUN=0 MON=1 TUE=2 WED=3
      THU=4 FRI=5 SAT=6 ?"
430   G=GET
440   GOSUB 1350
450   PRINT G
460   PRINT
470   G(5)=G.OR.10H :  REM   OR BIT4 TO IGNORE
      RESET FROM PIN 1
480   PRINT "ENTER TIME     HHMMSS"
490   G=GET
500   FOR Z=4 TO 2 STEP -1 :  REM   USE G(4) FOR HH,
      G(3) FOR MM, G(2) FOR SS
510   GOSUB 1350
520   PRINT G,
530   H=G*16
540   GOSUB 1350
550   PRINT G,
```

```
560   G(Z)=H+G
570    NEXT Z
580    PRINT
590    PRINT "IS THE TIME IN   0=24 HOUR FORMAT
       1=12 HOUR FORMAT  ?"
600   G=GET
610    GOSUB 1350
620    IF G<>1 THEN 680 :  REM   IF NOT 1 THEN JUMP
630   G(4)=(G(4).OR.80H) :  REM   OR BIT7 TO
      INDICATE 12 HOUR FORMAT
640    PRINT "IS IT   0=AM   1=PM  ?"
650   G=GET
660    GOSUB 1350
670    IF G=1 THEN G(4)=(G(4).OR.20H) :  REM      OR
       BIT5 TO INDICATE PM
680    REM   HOLD FOR TIME SYNCHRONIZATION
690    PRINT "HIT '0' TO GO SET THE NEW DATE/TIME"
700    GOSUB 1350
710    IF G<>0 THEN 700
720    GOSUB 1530 : REM STORE DATE/TIME INFO TO SMARTWATCH
730   XBY(4000H)=J : REM REPLACE BYTE TO 4000H
740   G=0
750    RETURN
760    REM
770    REM    ********* READ & DISPLAY DATE/TIME
780    REM
790   J=XBY(4000H)
800    GOSUB 1420 :  REM    SEND PATTERN RECOGNITION CODES
810    GOSUB 1230 :  REM   READ SMARTWATCH REGISTERS
820    PRINT "TODAY IS ",$((G(5).AND.7H)+1) :
       REM   STRIP OFF DAY OF WEEK
830   $(8)="  /  /  " :  REM   INITIALIZE DATE STRING
840   Z=7 :  REM   USE G(7) MM REGISTER
850   X=1 :  REM   PLUG CHARACTERS INTO STRING STARTING
      AT POSITION 1
860    GOSUB 1630 :  REM   GET 2 CHARACTERS FROM G(Z)
       AND PLUG INTO STRING $(8)
870   Z=6
880   X=4
890    GOSUB 1630
900   Z=8
910   X=7
920    GOSUB 1630
930   $(9)=$(8) :  REM   SAVE IT IN $(9) FOR ANY FUTURE USE
940    PRINT $(9)
950   $(8)="      .        " : REM INITIALIZE TIME STRING
960   G(9)=G(4)
970    IF (G(4).AND.80H)=0 THEN 1020 :
       REM   IF BIT7=0 THEN 24 HR FORMAT, JUMP
980    IF (G(4).AND.20H)=0 THEN ASC($(8),13)=41H :
       REM     IF BIT5 = 0, PLUG A
990    IF (G(4).AND.20H)=20H THEN ASC($(8),13)=50H :
       REM     IF BIT5 SET, PLUG P
1000  ASC($(8),14)=4DH :  REM    PLUG M
1010  G(9)=(G(4).AND.1FH) :
      REM   STRIP OFF FORMAT FROM HOUR REGISTER
1020  Z=9
1030  X=1
1040   GOSUB 1630
1050  ASC($(8),3)=3AH : REM PLUG IN THE CHARACTER FOR COLON
1060  Z=3
1070  X=4
1080   GOSUB 1630
```

(continued)

address location in RAM as a SmartWatch scratchpad.

When the first write cycle is executed, it is compared to bit 1 of the 64-bit comparison register. If a match is found, the pointer increments to the next location of the comparison register and awaits the next write cycle. If a match is not found, the pointer does not advance, and all subsequent write cycles are ignored. If a read cycle occurs at any time during pattern recognition, the present sequence is aborted, and the comparison-register pointer is reset.

Pattern recognition continues for a total of 64 write cycles until all the bits in the comparison register have been matched (this bit pattern is shown in figure 8). With a correct match for 64 bits, the SmartWatch is enabled, and data transfer to or from the timekeeping registers can proceed. The next 64 cycles will cause the SmartWatch to either receive or transmit data on DQ0, depending on the level of the $\overline{OE}$ pin or the $\overline{WE}$ pin. Cycles to other locations outside the memory block can be interleaved with $\overline{CE}$ cycles without interrupting the pattern-recognition sequence or data-transfer sequence to the SmartWatch.

The SmartWatch information is contained in eight registers of 8 bits each, which are sequentially accessed a bit at a time after the 64-bit pattern-recognition sequence has been completed. When updating the SmartWatch registers, each must be handled in groups of 8 bits. These read/write registers are defined in figure 9.

Data contained in the SmartWatch registers is in BCD (binary-coded decimal) format. Reading and writing the registers are always accomplished by stepping through all eight registers, starting with bit 0 of register 0 and ending with bit 7 of register 7. A few of the significant bits are the following:

• AM-PM/12/24 mode: Bit 7 of the hours register is defined as the 12- or 24-hour mode select bit. When high, the 12-hour mode is selected. In the

(continued)

```
1090  ASC($(8),6)=3AH
1100  Z=2
1110  X=7
1120   GOSUB 1630
1130  Z=1
1140  X=10
1150   GOSUB 1630
1160   PRINT $(8)
1170  XBY(4000H)=J
1180  G=0
1190   RETURN
1200   REM
1210   REM     ******** READ SMARTWATCH REGISTERS
1220   REM
1230   FOR Z=1 TO 8
1240  G(Z)=0
1250   FOR X=1 TO 8
1260  G=(XBY(4000H).AND.1) :  REM   G = BIT0
1270   IF G=0 THEN 1290 :
      REM    BIT = 0, DON'T ADD ANYTHING TO REGISTER BYTE
1280  G(Z)=G(Z)+(2**(X-1)) :
      REM   BUILD REGISTER BYTE FROM BITS RECEIVED
1290   NEXT X
1300   NEXT Z
1310   RETURN
1320   REM
1330   REM   ******** GET NUMBER 0-9
1340   REM
1350  G=GET
1360   IF G<48.OR.G>57 THEN 1350
1370  G=G-48 :  REM   ASC TO 0-9
1380   RETURN
1390   REM
1400   REM  ******** INITIALIZE PATTERN RECOGNITION CODES
1410   REM
1420  G(1)=0C5H
1430  G(2)=3AH
1440  G(3)=0A3H
1450  G(4)=5CH
1460  G(5)=0C5H
1470  G(6)=3AH
1480  G(7)=0A3H
1490  G(8)=5CH
1500   REM
1510   REM     ******** SEND REGISTERS TO SMARTWATCH
1520   REM
1530   FOR Z=1 TO 8
1540   FOR X=1 TO 8
1550   IF (G(Z).AND.(2**(X-1)))<>0 THEN G=1 ELSE G=0 :
       REM   STRIP OFF BIT
1560  XBY(4000H)=G :  REM   SEND BIT TO SMARTWATCH
1570   NEXT X
1580   NEXT Z
1590   RETURN
1600   REM
1610   REM  ******* GET 2 CHARACTERS FROM G(Z) REGISTER
1620   REM  ******* PLUG $(8) @ X
1630  G=INT(G(Z)/16)
1640  ASC($(8),X)=G+48
1650  ASC($(8),X+1)=G(Z)-(G*16)+48
1660   RETURN
1670   REM
1680   REM   ************ END
```

12-hour mode, bit 5 is the AM/PM bit with logic high being PM. In the 24-hour mode, bit 5 is the second 10-hour bit (20–23 hours).

- Oscillator and reset bits: Bits 4 and 5 of the day register are used to control the reset and oscillator function. Bit 4 controls the reset pin (pin 1). When the reset bit is set to logic 1, the reset input pin is ignored. When the reset bit is set to logic 0, a low input on the reset pin will cause the SmartWatch to abort data transfer without changing data in the watch registers. Bit 5 controls the oscillator. This bit is shipped from Dallas Semiconductor set to logic 1, which turns the oscillator off. When set to logic 0, the oscillator turns on, and the watch becomes operational.
- Zero bits: Registers 1, 2, 3, 4, 5, and 6 contain one or more bits that always read logic 0. When writing these locations, either a logic 1 or 0 is acceptable.

Reading and Setting SmartWatch in BASIC

While it is ultimately smarter to exercise the SmartWatch through an assembly-language routine, the universality of BASIC suggests that it would be a better tool for demonstrating the intricacies of communicating with SmartWatch. Listing 2 is a BASIC program that sets and reads a SmartWatch installed at 4000 hexadecimal on a BCC-52 computer/controller board. This program is more involved than the 5832 clock-chip program described earlier, primarily because it has more reporting features and communicates with the operator through menus. Embedded among all the REM and PRINT statements are the essential time-setting and read routines that you can translate from BASIC-52 to any other BASIC.

An Assembly-Language Firmware Utility

The assembly-language interface to the SmartWatch is also done on the bit level. The device requires that a particular pattern of 64 consecutive bits be written to data bit 0 in order to access the time and date registers

of the SmartWatch. Then, 64 more consecutive reads or writes are required to examine or set the watch.

The firmware EPROM consists of a set of routines that take care of manipulating the SmartWatch and conversion of the SmartWatch data from BCD to binary format (I call this firmware SmarTime). This allows the use of BASIC to directly read the data in memory with no conversion code necessary in the BASIC-52 program. Year, month, date, day of week, hours, minutes, seconds, and hundredths of seconds are made available in the BCC-52 data memory for reading by the user program. SmarTime uses 24-hour military time (00:00–23:59) in order to eliminate the need for an AM/PM indicator. If AM/PM time is required, you can convert it to the more standard format in BASIC.

The SmarTime system is contained within an EPROM at location 6000 hexadecimal (for this demonstration) and occupies 300 (hexadecimal) bytes of memory (the SmarTime routines can be reassembled to run in any available 300 [hexadecimal]-byte EPROM space on the board). The rest can be used by your application if desired, but be careful to put your data into the EPROM from the top down.

SmarTime stores its register save and load areas and date/time information in the area directly above BASIC-52's current MTOP pointer. Because of this, the MTOP address must be adjusted down by 30 bytes prior to calling the initialization routine at location 6000 hexadecimal. A memory map appears in figure 10.

Three basic functions are found in SmarTime (figures 11–14 outline the logic flow of these programs). The first is a routine that sets up the memory environment for SmarTime to use. This routine, executed with a CALL 6000H, creates a load table of information in the memory above MTOP. The table contains the base address of the SmartWatch device, as well as a pointer to where the time information is stored.

A second routine, invoked with a CALL 6003H, uses the binary data stored in the time and date fields to set the SmartWatch. The required control bits for establishing 24-hour time and for turning on the SmartWatch internal oscillator are added to the data prior to its being written to the SmartWatch device. The routine also does the binary-to-BCD conversion.

The third function of the software is a routine for reading out the SmartWatch date and time information, converting it from BCD to binary format, and storing it in the memory area above MTOP. It is executed with a CALL 6006H.

Using the SmartWatch with SmarTime is easy. With the DS1216 installed at address 4000 hexadecimal and SmarTime at 6000 hexadecimal, simply enter and run the program shown in listing 3.

SmarTime uses 24-hour military time to eliminate the need for an AM/PM indicator.

Finally, we are back to simple BASIC programs with the help of a little firmware tucked away in an EPROM. As this program runs, you should see the seconds location of the clock/calendar printed out once per second. If it is correctly incrementing, the EPROM is installed properly at location 6000 hexadecimal and the Smart-

(continued)

Program Memory	6000H–6300H		SmarTime EPROM-resident software
External Data Memory	Offset Above MTOP Value		Function
	DEC	HEX.	
	24	18	YEARS (00–99)
	23	17	MONTHS (01–12)
	22	16	DATE (01–31)
	21	15	DAY (01–07)
	20	14	HOURS (00–23)
	19	13	MINS. (00–59)
	18	12	SECS. (00–59)
	17	11	HUNDREDTHS of SECS (0.00–0.99)
	16	10	BANK 3 REG 7 LOAD (RESERVED)
	15	0F	BANK 3 REG 6 LOAD (RESERVED)
	14	0E	BANK 3 REG 5 LOAD (RESERVED)
	13	0D	BANK 3 REG 4 LOAD (RESERVED)
	12	0C	BANK 3 REG 3 LOAD (TIME AREA LOW)
	11	0B	BANK 3 REG 2 LOAD (TIME AREA HIGH)
	10	0A	BANK 3 REG 1 LOAD (RESERVED)
	09	09	BANK 3 REG 0 LOAD (WATCH BASE)
	08	08	BANK 3 REG 7 SAVE AREA
	07	07	BANK 3 REG 6 SAVE AREA
	06	06	BANK 3 REG 5 SAVE AREA
	05	05	BANK 3 REG 4 SAVE AREA
	04	04	BANK 3 REG 3 SAVE AREA
	03	03	BANK 3 REG 2 SAVE AREA
	02	02	BANK 3 REG 1 SAVE AREA
MTOP + = >	01	01	BANK 3 REG 0 SAVE AREA

Figure 10: *The SmarTime firmware memory map.*

Watch at location 4000 hexadecimal. You can now write your own BASIC-52 programs to use SmarTime.

In Conclusion

Either real-time clock I've presented is applicable and valuable in control applications. Which you use depends primarily upon the application. It took only a few hours to build and test the 5832 circuit, and it proved an immediate success for a one-shot problem. In the long run, however, the SmarTime system incorporating the SmartWatch and nonvolatile RAM is a more useful BCC-52 peripheral that can be easily duplicated, especially now that the software is written.

Speaking of software, the BASIC listings and a file of the SmarTime executable code (to run at 6000 hexadecimal) discussed in this article are available for downloading from BYTEnet Listings at (617) 861-9764 and the Circuit Cellar BBS at (203) 871-1988. They are also available from BYTE on disk (see page 358).

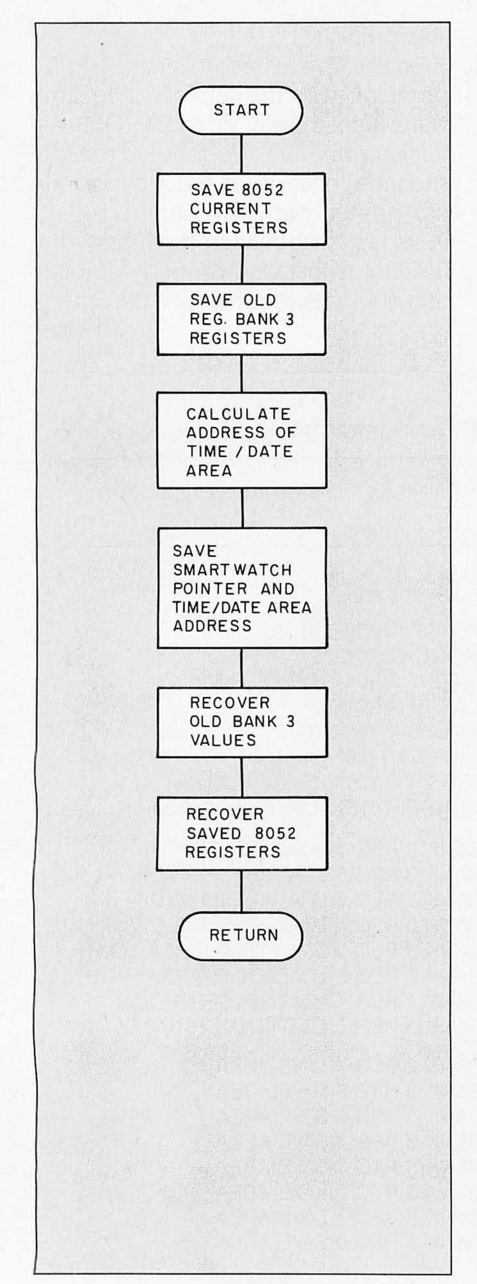


Figure 11: *The SmarTime firmware flowchart—the initialization routine.*

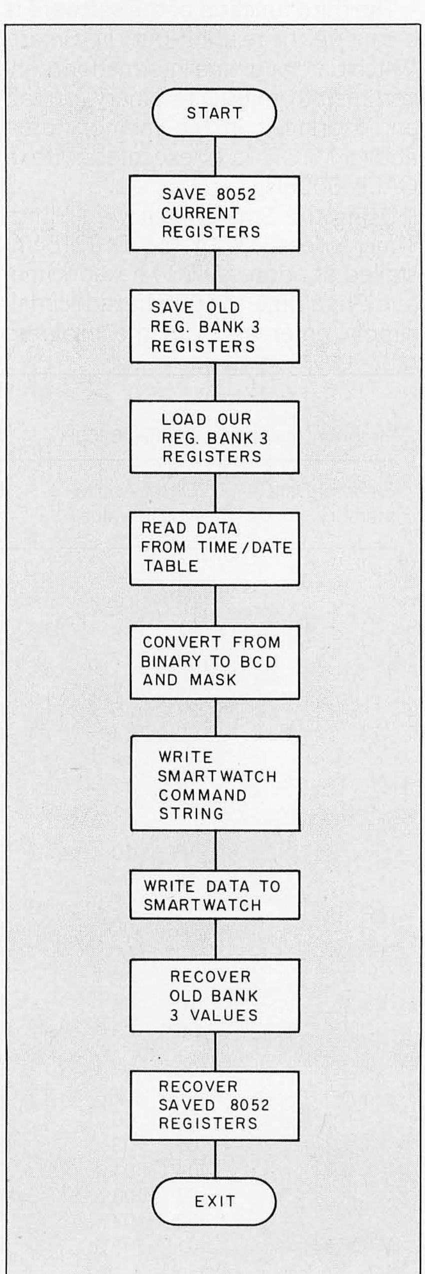


Figure 12: *The SmarTime firmware flowchart—a routine to set the SmartWatch.*

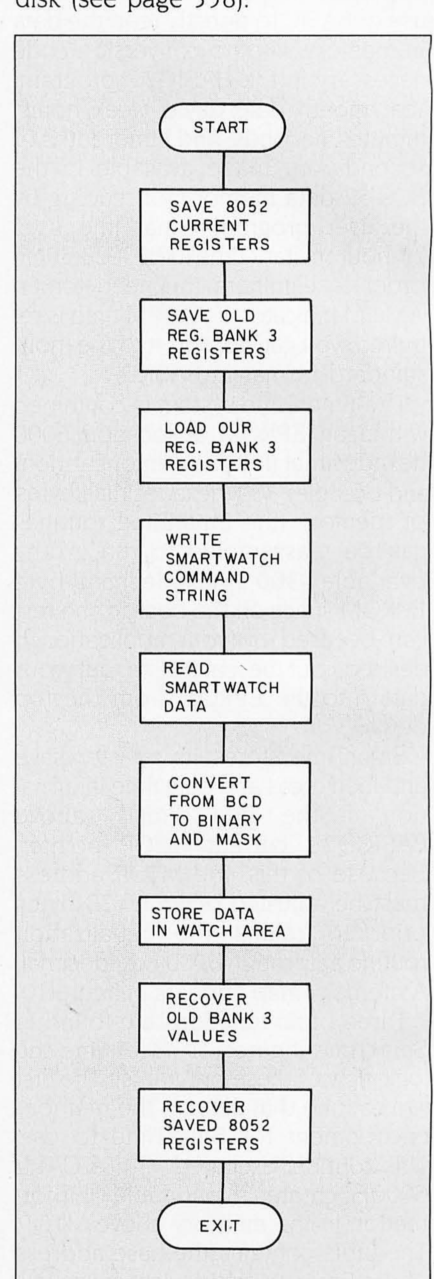


Figure 13: *The SmarTime firmware flowchart—a routine to read the SmartWatch.*

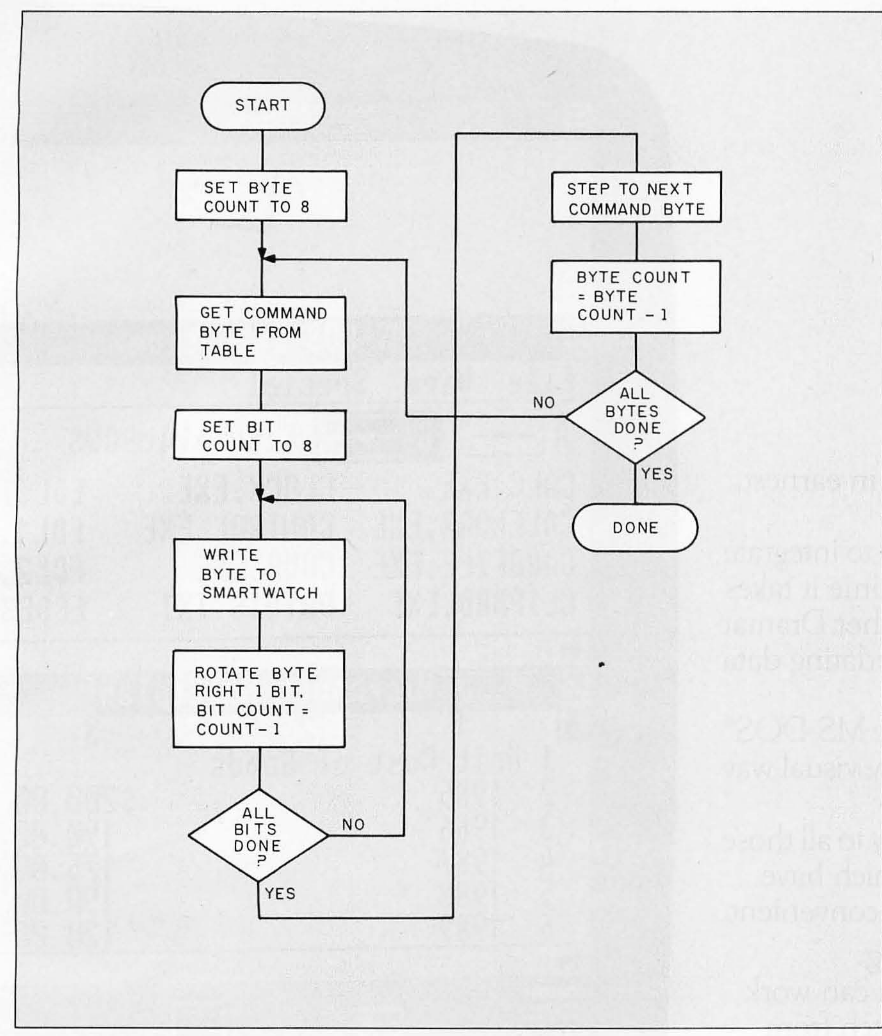


Figure 14: *The SmarTime firmware flowchart—a routine to write a command string or data to the SmartWatch.*

Listing 3: *This* BASIC *program uses the SmarTime firmware to update a seconds counter on screen. Note that comments in parentheses next to the code should not be entered as part of the program.*

```
10 MTOP = MTOP - 30    (RESET MTOP POINTER)
20 DBY(18H)=040H  (ASSUME SMARTWATCH AT 4000H)
30 CALL 6000H    (INITIALIZE THE SYSTEM)
40 REM NOW SET SMARTWATCH TIME
50 FOR X=MTOP+24 TO MTOP+17 STEP -1
60 READ C
70 XBY(X)=C
80 NEXT X
85 REM ZZ/01/85  14:25:00.00
90 DATA 85,11,01,05,14,25,00,00
100 CALL 6003H  (WRITE THE VALUES)
110 CALL 6006H  (READ THE VALUES)
120 PRINT MTOP+18 (SECONDS COUNTER)
130 GOTO 110
```

CIRCUIT CELLAR FEEDBACK

This month's feedback is on page 354.

NEXT MONTH

Beating your own security system: a personal experience. ■

Special thanks to Jeff Bachiochi and Bill Curlew for their software expertise.

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The BCC-52 SmarTime system consists of a DS1216 SmartWatch and a SmarTime firmware EPROM (ROM C) written in 8052 assembly language. The EPROM contains the assembled executable code (address 7D00 hexadecimal) and the power I/O system as described in the December 1984 Circuit Cellar. Using the assembler provided in the optional expansion utilities ROMs A and B, the SmarTime routine can be reassembled to execute anywhere in memory. The SmarTime manual contains the source file of the SmarTime utility.

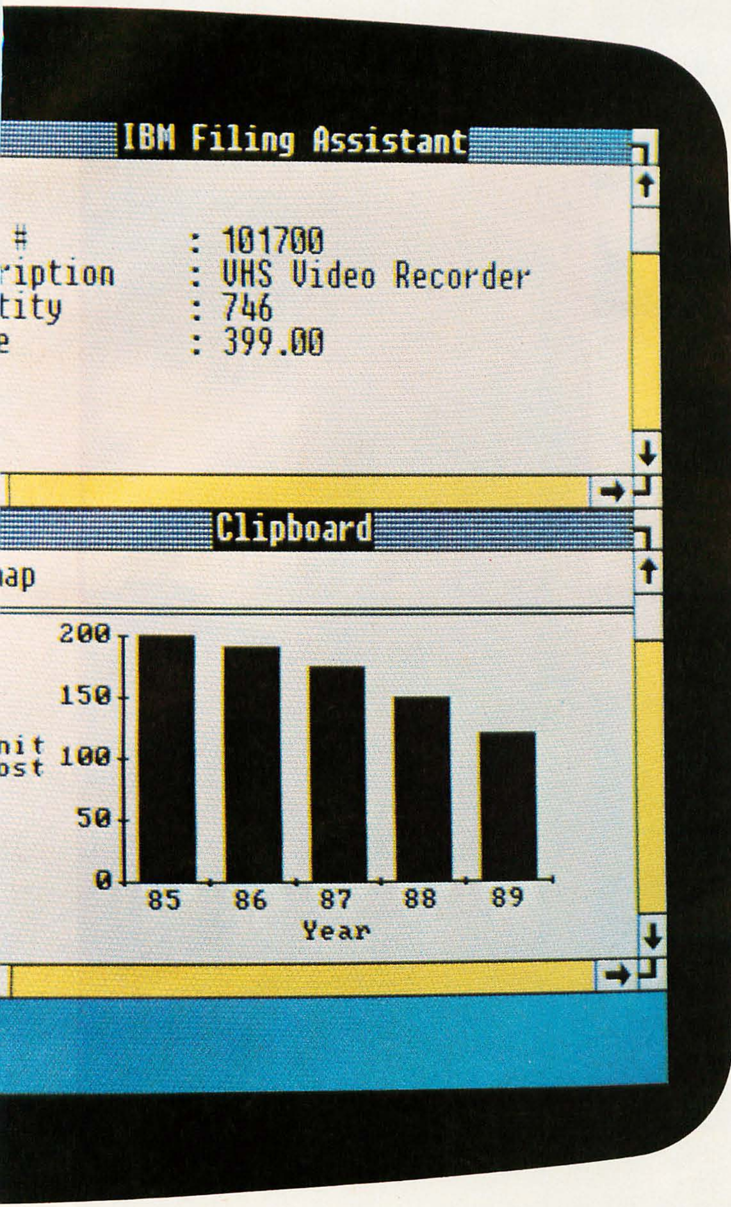
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Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in book form from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.

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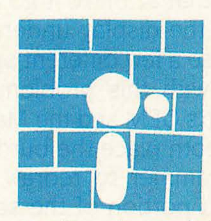
ILLUSTRATED BY ROBERT TINNEY

A SIMPLE WINDOWING SYSTEM

PART 1: BASIC PRINCIPLES

BY BRUCE WEBSTER

Windows can be implemented on almost any system with a memory-mapped display



The use of windows for user interfaces is not new; the Xerox Palo Alto Research Center has been developing window-based systems for years. But it wasn't until Apple released the Macintosh two years ago that windows became popular. Now, just about every major microcomputer has a window-based user interface available (if not actually bundled), and a wide range of software, from databases to games, uses windows as well.

Though windows are most often associated with high-powered bit-mapped computers, they can be implemented—and implemented well—on nearly any system with a memory-mapped display, be it graphics or text. There is nothing magic or secret about windows; the underlying concepts are easy to understand and usually easy to implement. Windowing systems can be and have been implemented on most of the more "mundane" computers; the goal of this article is to show you how. I will assume that you are using some existing set of graphics or text routines. Only a few routines are essential: a viewport or screen bounds command, to restrict writing or drawing to the current window; a clear screen or fill screen command, to erase the portion of the screen where the window will appear; a cursor-positioning command for text displays, to draw (if desired) a border of characters; and a line-drawing command for graphics displays, also to draw a border.

This month's installment will cover the basic principles of windows and then examine the problems involved in opening a window. Next month, I will look at how to close a window, develop a pseudocode implementation of a windowing system, and show an actual implementation on a specific computer.

UNDERSTANDING WINDOWS

A window is simply a small screen that appears within a larger screen (your computer's display). Its function is to let you perform some task within it, then disappear when it is no longer needed. Often, two or more windows are created, each with its own purpose, and you can then select which window to use. Figure 1 shows an example of multiple windows in use on the Macintosh.

When a window is created—or opened—it hides whatever is behind it, including portions of other windows that it might overlap. Usually, a border is drawn around the window to visually set it apart from everything

(continued)

Bruce Webster is a consulting editor for BYTE. *He can be contacted c/o* BYTE, *POB 1910, Orem, UT 84057.*

else on the screen; a title is sometimes placed at the top as well. Having opened the window, you can then do things within it: write text, draw pictures, or whatever your software allows you to do. Attempts to write or draw outside of the window should be ignored. This is usually done by using a viewport or screen bounds command.

You can write or draw in a window as long as it is active. If windows overlap, the one on top—that is, the one that is not overlapped by any other window—is the active one. If you have two or more nonoverlapping windows, only one is active at any given point in the program; for the sake of simplicity, I will always use the most recently opened window. Of course, by constantly switching between windows, you can give the illusion of multiple windows being active simultaneously. (It is even possible—though difficult, or at least tedious—to have partially obscured windows be active. Such a technique is beyond the scope of this article; you'll have to work it out on your own.)

Often, you will want to close a window, that is, make it go away and restore the display underneath it. You can use a few different approaches to deal with this problem. Digital Research's GEM and the Macintosh Toolbox both place the burden upon the programmer to redraw the now-exposed portion of the screen. This is done for two reasons. First, it saves memory, since nothing needs to be saved when the window first appears. Second, it makes it easy to reorder overlapping windows, that is, to bring a partially hidden window to the "top." The drawback is that your program must know how to redraw that portion of the screen and then take the time to do so.

The other approach is to save what is underneath a window when it is opened, then restore that to the screen when the window is closed. This uses up memory and/or disk space, since that screen data has to be stored somewhere. It also enforces a last-opened/first-closed restriction for overlapping windows. Suppose you open window A, then window B (which overlaps A), then window C (which also overlaps A), and finally window D (which overlaps B). You must close window D before you can close B, and you must close both B and C before you can close A. If two windows do not overlap (such as B

Figure 1: *An example of multiple overlapping windows on a Macintosh screen.*

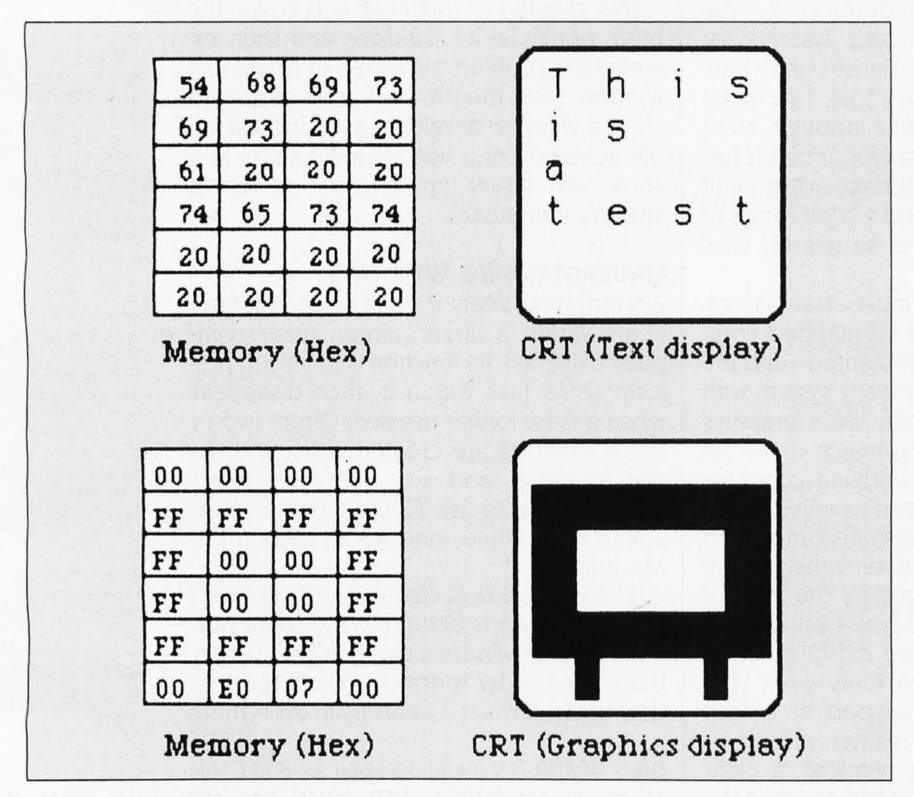


Figure 2: A *simple example of a memory-mapped text display (top row) and a memory-mapped graphics display (bottom row).*

and C), you can close either one independent of the other. The advantages of this method are that your program doesn't need to remember how to redraw anything, it can be very fast (if properly written), and it's simple. This is the approach that I will use in this article.

OPENING A WINDOW

Your first task is to open a window on the screen. You need to specify the location of the window (say, the upper left corner), the size of the window (width and height), and the address to save what is under the window.

In addition, you need to decide if the window will have a border and/or a title and (if so) how they will be drawn. I'll defer discussion of the borders and titles for a little while and concentrate on creating the window itself.

Notice that I've been vague as to whether your display is text (that is, a character-only ASCII display) or graphics (bit-mapped). The fact is, it doesn't really matter, as long as the display is memory-mapped and you can read from and write to that memory. Memory-mapped means that there is some area in RAM (random-access read/write memory) that corresponds to your display; anything written there appears on the screen in some form. In a memory-mapped text display, each byte usually represents a single character; the value of the byte is the ASCII value of the character being displayed. Memory-mapped graphics displays have more variety, depending upon the computer. One or more bits correspond to each dot on the screen; sometimes those bits are next to each other, sometimes they are quite a distance apart. See figure 2 for examples of memory-mapped displays.

The Apple II and the IBM Personal Computer have both memory-mapped text and graphics, while the Macintosh has only memory-mapped graphics. The main difference between the two kinds of displays is that the text display takes up less memory. For example, the 80-character by 25-line text-mode display on the IBM PC Color Graphics Adapter takes up 4000 bytes—2000 bytes for the 80 by 25 text itself and another 2000 bytes for attributes (bold, underline, etc.) for each character—whereas the graphics-mode display takes up 16,000 bytes (high resolution: 640 by 200 pixels, 1 bit/pixel; medium resolution: 320 by 200 pixels, 4 bits/pixel).

The amount of memory required by a graphics display increases proportionally to the resolution and/or the number of colors per pixel. One of the highest resolutions for a microcomputer display is that of the Amiga: 640 by 400 pixels, with 16 colors (4 bits) per pixel. A full screen at that

(continued)

resolution requires 128,000 bytes (640 × 400 × 4/8). By contrast, the original text display on the Apple II—40 by 24—requires only 960 bytes of RAM.

To keep this windowing system simple, you can assume that all windows start and end on byte boundaries. This means you won't split up any bytes, that a window will always be so many bytes wide. For text displays you have no choice, since each character takes up a byte. For graphics displays, however, you could try to work on the bit level, starting a window partway through a byte. But for most purposes this is unnecessary. Restricting the *x* coordinates of the window to byte boundaries makes your system easier and faster because your code doesn't have to do the shifting and masking that bit-level boundaries would require.

You need to specify the location of the window. Most of the popular microcomputers use the upper left corner of the screen as the starting point, or origin, for text or graphics. The first location in the memory map for the display corresponds to that corner; each successive location moves across to the end of the line, then to the start of another line (though, as Apple II programmers can tell you, not necessarily the next line down). By specifying the upper left corner of the window, you simplify the task of copying the underlying display memory to some other location. Since you're sticking to byte boundaries, you'll define the upper left corner as (*x*,*y*), where *x* is the left byte and *y* is the top line. You'll also define the upper left corner of the entire screen as (0,0); that is, the topmost line is 0, and the leftmost byte of each line is 0.

You now need to specify the width and height of the window. Two choices present themselves, each with its strengths and weaknesses. First, you could specify the coordinates of the lower right corner, (*x*2,*y*2). This would make it easier to avoid accidentally creating a window that extends beyond the screen boundaries, since you would have to deliberately specify illegal (out-of-range) coordinates. Second, you could give the width (in bytes) and height (in lines) of the window. This makes it clearer how big the window actually is. Arguments can be made for either method, and it is simple to implement either one. For now, let's go with the second, naming the parameters (width,height). You can then calculate (*x*2,*y*2), since *x*2 = (*x*+width−1) and *y*2 = (*y*+height−1).

Finally, you need to specify the address of the buffer, that is, the area where the underlying screen data will be saved. You will need at least width×height bytes of storage; "at least," because you may also want to store the information describing the position of the window (*x*,*y*,width, height) in the buffer, to make restoration of the screen data easier. Assuming you use 2 bytes for each of those values, you'll need a total of (width× height + 8) bytes.

You now need to make some decisions concerning error checking. The following cases must be handled somehow:

1. The coordinate *x* and/or *y* is out of range; i.e., it is less than 0 or greater than the maximum allowable value.
2. Width and/or height is too large; i.e., *x*2 and/or *y*2 is out of range.
3. The buffer isn't big enough to save the screen data.

You can take two general approaches. First, you can try to make things "fit." For example, if *x* is negative, you can set it to 0 and proceed anyway; likewise, if the window boundaries extend below the bottom edge of the screen, you can chop off the excess. This is dangerous, however, since the calling program will get something other than it requested. The alternative is to return an error code, informing the calling routine that the window was not opened and the reasons why. The program can then take whatever steps are necessary to adjust its request. This second approach is safer, and we'll take it.

You now need to deal with the issue of memory management. Two separate problems present themselves. First, you must decide how much memory to give to the window buffer or buffers. A simple solution is to find and set aside a chunk of memory (a "window buffer") equal in size to the largest window that you'll let be opened. Ideally, this would be the same size as the actual display, so that you could open up a window filling the entire screen. This is feasible for a 40 by 24 text display on the Apple II—but it might not be feasible for the 280 by 192 graphics display on that same Apple II, especially if you have 64K bytes (or less) of total memory. If you don't have enough free RAM, you'll need to set aside some lesser

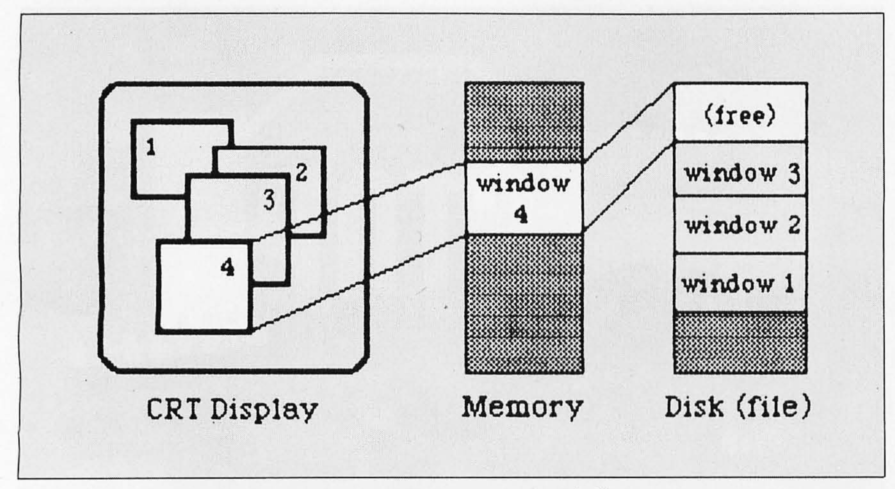


Figure 3: *If you run out of RAM for storing window buffers, you can save some of those buffers to disk.*

amount and let the open-window routine know what that amount is. It can then compare that size to the value (width × height + 8) and return the appropriate error code if it's not large enough. For now, assume that you've set aside as much RAM as you can spare, and that the address and size of that buffer are known to the open-window routine. (If your language lets you dynamically allocate memory, you may want to use that to create the buffer as needed.)

The second problem occurs when you run out of available RAM for storing window buffers. You can, of course, just refuse to open the window. But that might be too much of a limitation, especially if you have only enough memory for a single buffer (and, therefore, a single window). One alternative is to write the buffer out to disk, then reuse the buffer for the new window. This involves more record keeping, as well as a check to be sure you have sufficient room on the disk. Again, the simplest solution here is to set aside an area on the disk big enough to hold some fixed number of fixed-size buffers. Each time you open a new window, you write the current contents of the buffer out to the next free slot on the disk (see figure 3). Once the disk area is full, you return the "too many windows" error message on any further attempts to open a window.

The final decision is how to handle borders and titles. Let's drop titles but keep borders. For text displays, this is simple. You can draw the border using any special characters provided (like the IBM graphics characters or the MouseText characters on the Apple IIc and enhanced IIe) or by adapting some regular characters, like dashes, exclamation points (or vertical bars, if your display supports them), and plus signs. But you'll need to decide whether the border is inside or outside the window. The border itself will eat up two lines (top and bottom) and two columns of bytes (left and right).

If you put the border inside the window, the display area within the window itself will be smaller; for example, if you create a window that's 20 bytes wide and 10 lines high, the actual "screen" within the window will be only 18 bytes wide and 8 lines high. If the border is outside the window, you have to handle the cases where the window is flush against one or two sides of the screen, such as a window whose upper left corner is at (0,0). You'll also have to be sure to save the areas covered by the borders, so your actual buffer size may be as great as (width+2)*(height+2) bytes. For this article, I'll assume that the border is within the window; you may want to design your own routines otherwise.

For graphics windows, the problems are similar. Drawing a border is quite simple: a line across the top and bottom lines and along the left and right sides. Given the previous decision to limit windows to byte boundaries, there is no real "inside/outside" choice, unless you want to pad the left and right sides by a full byte (which may represent several pixels of "empty" space on each side). Again, I'll assume that the border is within the graphics window; again, you may decide otherwise for your own implementation.

The final thing you must do is set the viewport (or active screen) to the "screen" within the border, if possible. The graphics or text routines you're using may allow you to define those limits; if so, you want to set them at $(x+1,y+1,x2-1,y2-1)$. On a graphics display, you may want to leave a little gap between the border and the drawings within the window. You may also want to set the x values on a bit boundary rather than a byte boundary, if you can, to avoid too large a gap on either side.

INTERMISSION

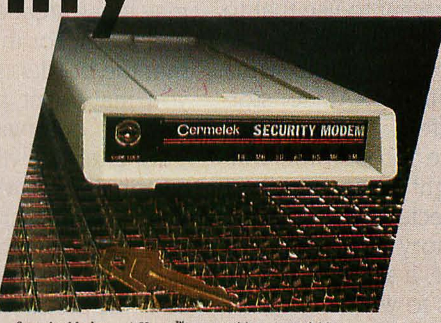
You should now have a good idea of what you must consider in opening a window: how to specify it, where to save the screen data, what to do when errors occur. Next month, you'll learn how to close the window again. You'll also see a pseudocode implementation of the system I've developed here, as well as a partial translation for an Apple II. ■

AD SERIES #1

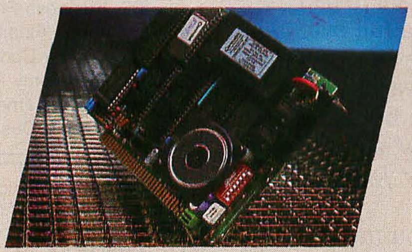
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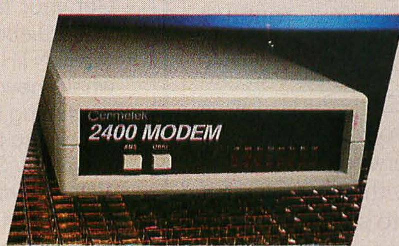
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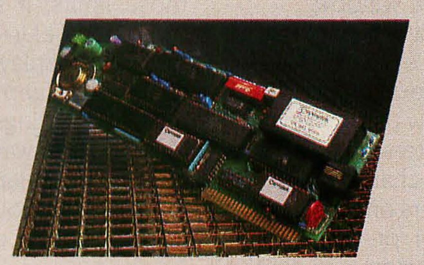
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AppleMate 1200 Modem – A Hayes™ compatible internal modem card designed for the Apple™ II, II+, IIe with intelligent features and built-in diagnostics.

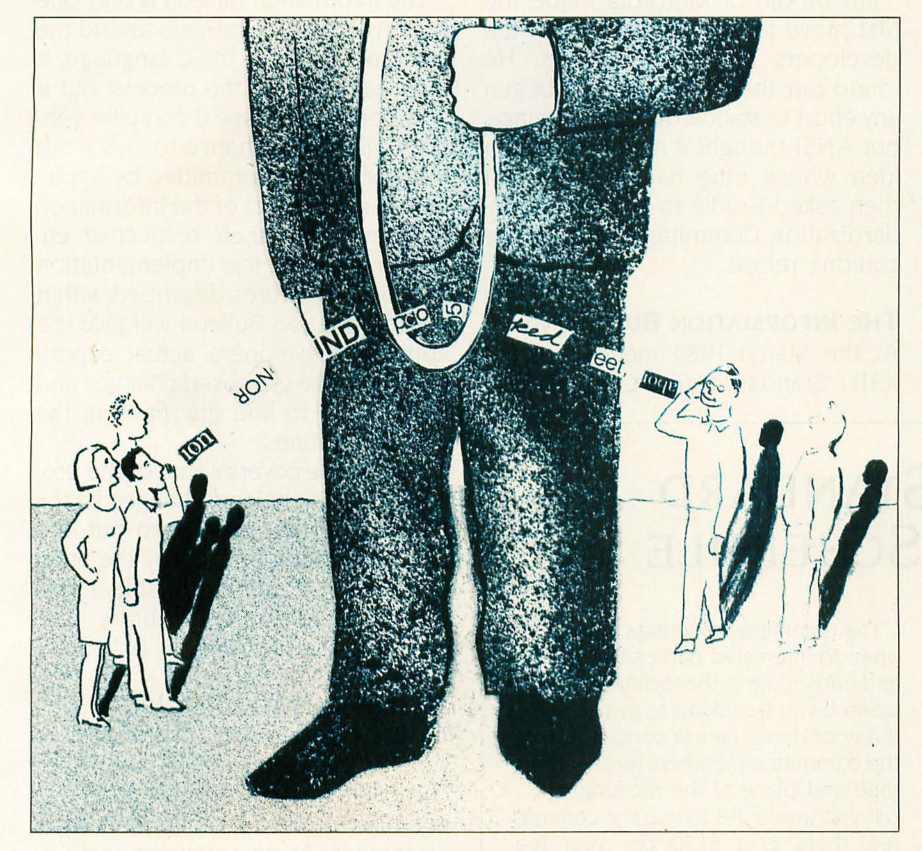


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BY STEVE A. HERSEE AND DAN KNOPOFF

AN ANSI STANDARD FOR THE C LANGUAGE



A description of the standard proposed in the X3J11 committee's Information Bulletin

In *The C Programming Language* (Prentice-Hall Inc., 1978) Brian W. Kernighan and Dennis M. Ritchie defined C as "a general-purpose programming language which features economy of expression, modern control flow and data structures, and a rich set of operators." The C language was first developed for use on the UNIX operating system; however, C is now widely accepted in the personal computer arena, and it is no longer just the godchild of UNIX developers. There is now enough interest and investment in C to develop an American National Standards Institute (ANSI) standard for C. The process is currently underway and entrusted to the X3J11 Standardization Committee.

WHY DEVELOP A STANDARD?

As more developers and users become dependent on C, a universal set of rules is necessary to keep C programmers working with the same language. The challenge then is to establish a nonpartisan keeper of the "standard."

At first, the choice appears to be easy. Why not let the compiler implementors and developers (such as AT&T, Whitesmiths, or Lattice) hammer out their own language definition? But could any of these organizations actually claim that changes and additions would be implemented to serve the public good?

The C language already has a de facto standard taken from Kernighan

(continued)

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ILLUSTRATED BY BARBARA ENSOR

and Ritchie's book (known as K&R). K&R was published in 1978 as both a tutorial and an "official" statement of the syntax and semantics of C. However, due to ambiguities in the text, UNIX references, and recent extensions to C (such as the portable C compiler), K&R is not always the most viable alternative for a compiler writer to follow. In fact, a C compiler author has almost too many choices. Should an author of a C compiler provide the C described by the K&R standard or should the UNIX version 7 be used? Or how about UNIX System III? Or Whitesmiths (the oldest commercial compiler)?

The standardization of C will allow C to move into more environments. Since the standard addresses just the C language, the variations between operating systems can be filtered out (they are never really eliminated), and C can move away from its original UNIX roots. In fact, two-thirds of the Standardization Committee's members represent companies offering C for non-UNIX environments.

An ANSI standard for the C language will allow C to grow in an orderly way, without the problems that many other languages have had. The standard will also allow C to "grow up" without being controlled by a single compiler implementor or operating system.

Jim Brodie of Motorola made the first move to wrest C away from the developers and implementors. He found out that ANSI had not begun any effort to standardize the language, but ANSI thought it sounded like an idea whose time had come. ANSI then asked Brodie to chair the Standardization Committee—an offer he couldn't refuse.

THE INFORMATION BULLETIN

At the March 1984 meeting of the X3J11 Standardization Committee in Chapel Hill, North Carolina, the Committee voted to publish the current draft of the ANSI C Language Standard as an ANSI Information Bulletin. (This draft is published by the Computer & Business Equipment Manufacturers Association [CBEMA].) See the text box "ANSI C Standard Meeting Schedule" for the address and information about the Standardization Committee.

The Information Bulletin is only one step in a multistep process toward the standardization of the C language. It is an early step in the process, but it is important because C compiler vendors will have a chance to check out the work of the committee by implementing all or part of the Information Bulletin within their respective environments. The test implementation of the new features described within the Information Bulletin will give the compiler developers actual experience with the proposed changes and allow them to find any flaws in the present features.

This article covers some of the proposed additions and changes to the C language that have been put into the Information Bulletin by the Standardization Committee. Table 1 lists the standard function library proposed in the Information Bulletin.

ANSI C STANDARD MEETING SCHEDULE

If you are interested in participating in the C standardization, call or write

Jim Brodie
Chairman
X3J11 Standardization Committee
Motorola Microsystems
2900 South Diablo Way
Tempe, AZ 85282
(602) 438-3456

or

Tom Plum
Vice Chairman
X3J11 Standardization Committee
Plum Hall
1 Spruce Ave.
Cardiff, NJ 08232
(609) 927-3770

The 1986 schedule for meetings is

March 3–7, Palo Alto, CA
June 2–6, Philadelphia, PA
September 8–12, Chicago, IL
December 8–12, Cary, NC

The committee meetings have been open to interested parties to observe and participate in the technical discussions. If you would like to just sit in for a day or more, please contact one of the committee members for the exact time and place of the meeting.

If you would like to join the committee, there is a $150 per year fee payable to

ANSI
Computer & Business Equipment Manufacturers Assocation
X3 Secretariat CBEMA
311 1st Street NW, Suite 500
Washington, DC 20001

The committee meets for one week every three months. All participants are volunteers and are responsible for their own expenses. Besides the meeting, committee members are required to prepare papers for presentation to the committee and to contact other members about the issues before the next meeting.

EXTENSIONS TO UNSIGNED

In K&R, the keyword unsigned is a type of integer or int. In many later compilers the keyword unsigned was extended to be a modifier as well as an integer. As an extension to K&R, the committee added unsigned char, unsigned short, unsigned int, and unsigned long to the normal use of unsigned. This modification is considered to be an easy extension to K&R, as it will not break any existing programs.

UNIQUE MEMBER NAMES

The standard proposed allows unique member names within structures and unions. C programmers will then be able to use the member name "Name," for example, in many different structures without having to

(continued)

Table 1: *The* ANSI C *standard library.*

```
assert(int expression)
isalnum(int c)
isalpha(int c)
iscntrl(int c)
isdigit(int c)
isgraph(int c)
islower(int c)
isprint(int c)
ispunct(int c)
isspace(int c)
isupper(int c)
isxdigit(int c)
tolower(int c)
toupper(int c)

acos(double x)
asin(double x)
atan(double x)
atan2(double x)
cos(double x)
sin(double x)
tan(double x)
cosh(double x)
sinh(double x)
tanh(double x)
exp(double x)
frexp(double value, int *exp)
ldexp(double value, int exp)
log(double x)
log10(double x)
modf(double value, double *iptr)
pow(double x, double y)
sqrt(double x)
abs(int i)
ceil(double x)
fabs(double x)
floor(double x)
fmod(double x, double y)

setjmp(jmp_buf env)
longjmp(jmp_buf env, int val)
signal(int sig, void (*func)() )
kill(int pid, int sig)
va_start(va_list ap, parmN)
va_arg(va_list ap, type)
va_end(va_list ap)
remove(const char *pathname)
rename(const char *old, const char *new)
tmpfile(void)
tmpnam(char *s)
fclose(FILE *stream)
fflush(FILE *stream)
fopen(const char *filename, const char *type)
freopen(const char *filename, const char *type, FILE *stream)
setbuf(FILE *stream, char *buf)
fprintf(FILE *stream, const char *format, . . .)
printf(const char *format, . . . )
scanf(const char *format, . . .)
fscanf(FILE *stream, const char *format, . . .)
sprintf(char *s, const char *format, . . .)
sscanf(char *s, const char *format, . . .)
vfprintf(FILE *stream, const char *format, va_list arg)
vprintf(const char *format, va_list arg)
vsprintf(char *s, const char *format, va_list arg)
```

```
fgetc(FILE *stream)
fgets(char *s, int n, FILE *stream)
fputc(int c, FILE *stream)
fputs(const char *s, FILE *stream)
getc(FILE *stream)
getchar(void)
gets(char *s)
putc(int c FILE *stream)
putchar(int c)
puts(const char *s)
ungetc(int c, FILE *stream)
fread(void *ptr, size_t size, int num, FILE *stream)
fwrite(const void *ptr, size_t size, int num, FILE *stream)
fseek( FILE *stream, long offset, int ptrname)
ftell(FILE *stream)
rewind(FILE *stream)
clearerr(FILE *stream)
feof(FILE *stream)
ferror(FILE *stream)
perror(const char *s)

atof(const char *buffer)
atoi(const char *buffer)
atol(const char *buffer)
strtod(const char *buffer, char ** endbuffer)
strtol(const char *buffer, char ** endbuffer, int base)
rand(void)
srand(unsigned int seed)
calloc(unsigned int num, size_t elsize)
free(void *ptr)
malloc(size_t size)
realloc(void * ptr, size_t size)

abort(void)
exit(int status)
getenv(const char *name)
onexit(onexit_t func)
system(const char *string)
memcpy(void *toadd , const void *fromadd, size_t length)
memset(void *s, int initchar, size_t n)
strcpy(char *to, const char *from)
strncpy(char *to, const char *from, size_t n)
strcat(char *to, const char *from)
strncat(char *to, const char *from, size_t n)
memcmp(const void *s1, const void *s2, size_t n)
strcmp(const char *s1, const char *s2)
strlen(const char *s1)
strncmp(const char *s1, const char *s2, size_t n)
memchr(const void *s, int c, size_t n)
strchr(const char *s1, int c)
strcspn(const char *s1, const char *s2)
strpbrk(const char *s1, const char *s2)
strrchr(const char *s int c)
strspn(const char *s1, const char *s2)
strtok(char *s1, const char *s2)

clock(void)
time(time_t *timer)
asctime(const struct tm *timeptr)
ctime(const struct tm *timer)
difftime(time_t time2, time_t time1)
gmtime(const time_t *timer)
localtime(const time_t *timer)
```

worry that it must be the same displacement in each structure. All structures and unions have their own name space, and the compiler will keep track of the valid member names for each. This may cause trouble for programmers with old code that defined structures or unions and then used the member names as a general value to be added to wherever they wanted.

Passing and Assigning Structures

The committee has incorporated the use of passing and assigning structures (as currently available within UNIX System V) into the Information Bulletin. This means that programmers will be able to assign one structure to another, to pass an entire structure as an argument on the stack, and to have a function return a value to its caller that is an entire structure. These features allow functions to work on structures that are copies of the original structure and then allow an assignment to update the original structure when all of the changes are complete.

The Bell Character

Programmers will now be able to send the ASCII Bell character as an alert to the end user by including a \a as an output string literal. Additional terminal support was considered, but the number of hardware choices and the constraints necessary to keep the committee focused on the language left the \a option the only hardware-related feature included within the Information Bulletin.

International Trigraph Character Operators

The C language has "used up" the ASCII character set. This is not a problem for programmers in the U.S., but it is a problem for programmers in other countries. It seems that some of the characters used as C operators are known as alphabetic extenders and are required in German, Spanish, French, and other foreign languages.

To make C easier to use internationally and to promote a wider use of C as an international language, the committee chose to address the problem of the "overused" ASCII character set within the Information Bulletin by defining a group of trigraph character sequences to act as operator equivalents. The trigraphs allow characters to be defined that are not in the ISO (International Organization for Standardization) 646 Invariant Code Set (see table 2), a subset of the 7-bit ASCII code set.

As part of the trigraph feature, the character sequence of \? has been defined as a ? to provide an escape for the sequence when a program is printing out a trigraph.

Keyword Changes

The committee has brought five keywords into the proposed ANSI C language described in the Information Bulletin. Keywords were added with caution because programs being updated to the ANSI C language may have to be changed if a keyword were used for some other function. The five new keywords are qvoid, enum, const, signed, and volatile.

The keyword void has been added to the Information Bulletin from UNIX System V to allow the programmer to define a function that returns no value. For example, the program segment

```
extern void exit();
```

tells the compiler that no meaningful value is expected from the return of the function exit. This allows the compiler to flag the following expression as an error:

```
a = b + exit();
```

The type enum has been added to the Information Bulletin exactly as it is used in UNIX System V. The type enum is similar to an enumeration type in Pascal but implemented in the spirit of the C language.

The keyword const is already in use by internal AT&T C compilers. The keyword const is a type specifier that defines an object that is either not to be modified or is resident in ROM (read-only memory). A const type object cannot be assigned to, incremented, or decremented. There are two major benefits of the const type: Data can now be identified that is not to be altered either in a module or in the entire program, and data to be placed into ROM can be identified as a specific group. After identifying data as const, the data can be checked by the compiler to flag an error if the programmer tries to alter the data of type const.

The C language as defined within K&R allows compiler implementors to choose whether they wish the type char to be a signed value or an unsigned value. This allows the compiler implementor to obtain the maximum possible speed for code generation in working with items of type char. This means that when the programmer adds the type modifier unsigned to char, the value is unsigned. But what about signed values? The keyword signed has been included within the Information Bulletin to allow signed values to be generated.

Adding the keyword signed to C also eliminates the problem where the natural char is unsigned and the programmer cannot receive a signed char value between −128 and +127. With the addition of the keyword signed the programmer has full control over whether the char is signed, unsigned, or chosen by the compiler.

The type modifier signed can be used anywhere that the type modifier unsigned is allowed. This allows the programmer to be very specific in the declaration of a variable to help the program's readability and performance.

The keyword volatile can be used by

(continued)

Table 2: *The trigraphs and the operators they define.*

Trigraph	??=	??(	??/	??)	??'	??<	??!	??>	??-
Character Defined	#	[	\	]	¨	{	¦	}	~

the programmer to describe the compiler's environment. Currently, after a compiler loads a value into a register (if a programmer does nothing to that value through the program), the value in the register is the same as the location in memory that was used to load the register in the first place. There are some pitfalls with this, however. For instance, what if the memory location is a memory-mapped I/O location such as a communication port? Or what if the location is a shared memory location that can be modified by another process? The value loaded into the register at one time will not be the same after time has passed or some event has occurred.

There is a real conflict between the basic compiler assumption that once a value is loaded into a register, there is no reason to reload that particular value if there has been no action to modify the memory location. The basic model of memory and the compiler in K&R did not allow the programmer to describe the condition where a memory location can be altered by events outside of the knowledge of the compiler. This is most evident in a multiprocessing environment like UNIX. If there is an area of shared memory, the location that the compiler is operating on may have changed since the last time the compiler looked at it.

The real plus with the keyword volatile is that the quality of compiler optimization can be improved, as the programmer will be better able to describe the underlying compiler environment. This allows greater optimization on normal variables and the proper handling of special data areas in various machines.

The keyword entry was dropped because it does not have a use in K&R.

LONG AND UNSIGNED INTS

In the C language, a constant (123, for example) is considered to be an int. As an int, it is a signed value of a known size that can be used in expressions with other ints. When a constant appears in an expression that also includes long types, the constant can be followed with the letter l to mean long (123l and 123L are examples of long ints).

This works fine until constants are used as addresses. Addresses do not make sense as signed values. Addresses make sense only as unsigned values. The Information Bulletin allows constants to be specified that have a trailing u to define the value as an unsigned value (123u and 123U are examples of unsigned values). The trailing u for unsigned values will allow programmers to force address and other expressions to be performed with unsigned arithmetic.

SHORT, INT, AND LONG LENGTHS

Compilers based on K&R use the keywords short or long as synonyms for an int. Normally on 16- and 32-bit machines a short and an int are both 16 bits, while a long is 32 bits. In the ANSI C language proposed by the Information Bulletin, all three types may be different lengths. For example, a large machine could have a short that is 16 bits, an int that is 32 bits, and a long that is 64 bits. Allowing short, int, and long to be different lengths may prove most useful on some of the larger machines. However, it is not a requirement to have three different sizes, so that the actual sizes can be specified by the compiler implementor.

ADDITIONS TO C FOR THE FORTRAN COMMUNITY

Since the C language has become popular, many FORTRAN programmers have been considering changing to C. To encourage the changeover, the committee implemented three additions to the proposed ANSI C language to make C more adaptable to the needs of the FORTRAN user. The additions include

- evaluating expressions with float (floating-point) arithmetic;
- being able to force the order in which expressions are evaluated; and
- creating a new type of float larger than double.

The Standardization Committee was careful to address these issues to allow implementation without forcing current C programs to be changed.

Elements in an expression can now be defined at the float type level. This allows the expression to be evaluated with float arithmetic rather than in double precision, which in turn allows a programmer to choose between speed and accuracy when performing arithmetic.

The unary + operator was added to allow a programmer to force an element in an expression to be evaluated before other parts of the expression. For example, if a programmer writes A + (B + C) the C compiler is free to add A and B first and then C. The only way to force B+C to be computed first is as follows:

```
temp = B+C;
Answer = temp + A;
```

Unfortunately, the use of a temporary variable requires the programmer to declare an additional variable and may change the style of coding. The Information Bulletin allows the expression to be written as A + +(B + C). The extra, or unary, plus sign tells the compiler to evaluate the expression inside of the parentheses first and then to go on with the remainder of the expression.

The third feature to help the FORTRAN community is the creation of a new type of float that is larger than double. This type is called long double. The long double type can be the same as double, but it can also be of greater precision than double. The long double type allows the writer of the math library functions to use a precision that is greater than normal. Intel uses this same idea with its 8087 math chip, where the data in and out of the chip is 64 bits while the 8087 chip does its internal calculations in 80 bits.

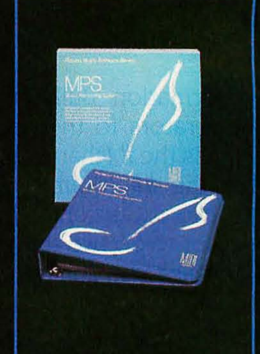
THE PREPROCESSOR

The C language preprocessor is a strange and wondrous beast open to interpretation by the compiler writer to determine just exactly what to do with the preprocessor phase of the compiler.

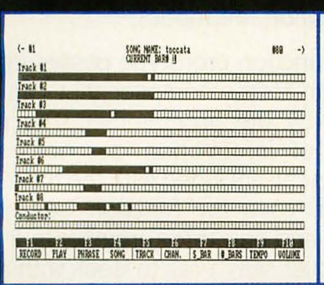
The preprocessor, as described by

(continued)
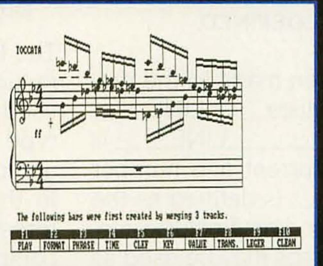
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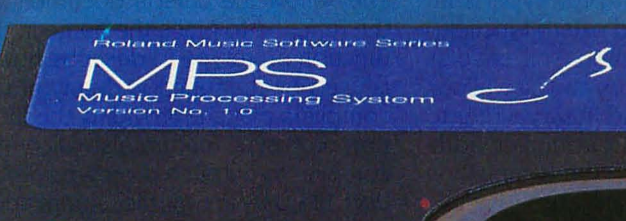


Song Mode, Arrange Page



Score Mode, Analysis Page





Roland Music Software

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the Information Bulletin, adds two new operators to the preprocessor. The first is the # (sharp sign), and second is the ## (double sharp sign). These two extensions allow the preprocessor to do two things that have been available in some (but not all) C compilers. Both of the tokens have to do with strings and macros. Many programmers like to have a macro to construct a value that is later used as a string or as a new token such as a variable name. These may sound like simple needs at first, but there are a number of problems that current programming solutions do not address. Maybe the best way to describe this is through the example included within the Information Bulletin:

```
#define debug(s,t) printf("x" # s
  "= %d, x" # t "= %s",x##s,x##t)
debug(1,2)
```

results in

```
printf("x" "1" "= %d, x" "2"
  "= %s",x1,x2)
```

which, after concatenation of the adjacent strings, results in

```
printf("x1 = %d, x2 = %s",x1,x2)
```

The #, when followed by a formal parameter of a macro, is replaced by the corresponding macro argument and is enclosed in quotes. This is shown above when, #s become "1." This allows the easy creation of string literals from macros. The ## is the token concatenation operator. In a macro expansion after all replacements have taken place, each ## is removed and the tokens preceding and following each ## operator are concatenated.

EXPANDED STRING LENGTH

The above examples contain another proposed change to current C usage. The proposed ANSI C language allows strings to be longer than those in current use. The programmer can construct a string from more than one line when the lines appear as adjacent strings within a C program. The lines are logically concatenated into one string. This means that the following two examples are equivalent:

Example 1:

```
printf("this is a single string with the
  numbers one, two, and three \ ");
```

Example 2:

```
printf("this is a" " single string"
                   " with the "
                   "numbers "
                   "one,"
                   " two and three");
```

CHANGE TO PREDEFINED MACRO VALUES

A change has been made to the predefined macro values __LINE__ and __FILE__. __LINE__ is defined as the current line number and __FILE__ is defined as the current source and/or #include filename. These macros may be used as references to print out information concerning the current file and line number.

ADDITION OF #PRAGMA

The #pragma preprocessor directive has been added to the proposed C language to allow compiler writers to get additional information to their compiler without having to invent a new set of implementation keywords. The #pragma macro acts as a general escape mechanism to make any environment/feature/extension information truly portable between compilers. Any information appearing on the #pragma line that is not recognized by the compiler and/or is not specific to the environment is ignored and is not flagged as an error.

FUNCTION PROTOTYPES

Function prototypes are a major addition defined within the Information Bulletin. A function prototype is an expansion of the old extern function() syntax. The new syntax still enables the old syntax to work and also allows the programmer and library writer to give the reader and compiler additional information on the compilation process.

A common problem that involves function calls can be demonstrated by the function lseek. The function lseek has three arguments, and it returns a long value. In usage, the function is given as

```
extern long lseek( );
```

This form is still viable and will continue to work in existing programs. The proposed ANSI C language defined within the Information Bulletin allows the addition of the function prototype:

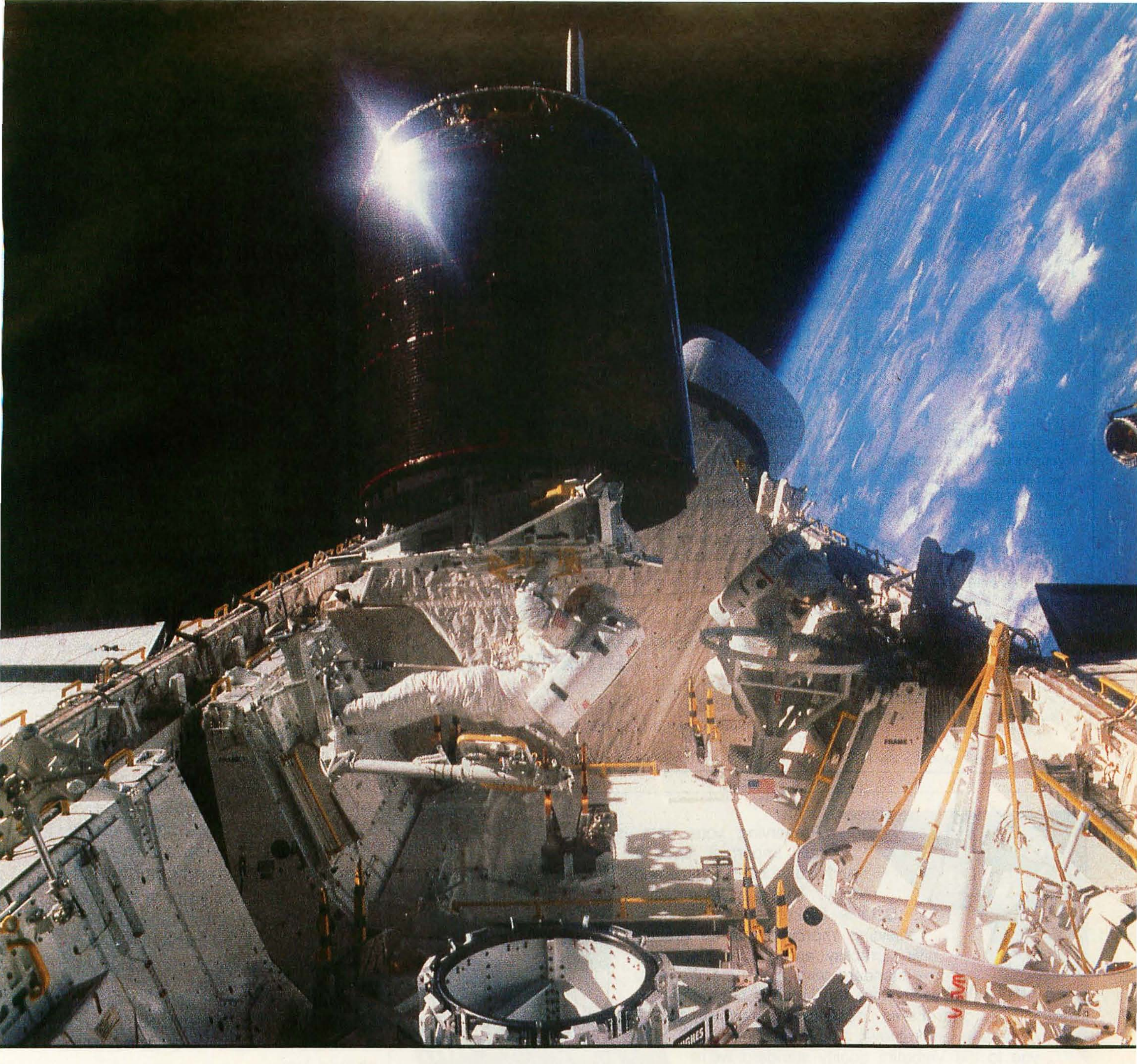
```
extern long lseek(int file, long
  position, int mode);
```

The function prototype passes information to the compiler that can be used by the programmer. The first type of information describes the arguments included with the function. In this case, the function lseek has three and only three arguments. If the compiler sees a call to lseek with anything other than three arguments, that lseek call is an error. The function prototype also converts the value to the type specified when the second argument is not a long value. The conversion is performed as if it were being assigned across an equals sign.

This type checking for function calls is a very large part of the UNIX utility lint. Function prototype checking is more powerful than lint, however, because it is performed at compilation time by the compiler rather than as a separate utility after the program is compiled. Also, as all of the standard library header files have the library function prototypes in them, the programmer is notified of both the argument count and improper type errors when the program is compiled, not at some later time during a debugging session or a lint pass.

The names in the function prototypes are optional for readability. They allow the person documenting the function to place the name in the function prototype to describe how it is used by the function. Many of the compilers that are providing the function prototype feature also allow the compiler to output a prototype definition file as part of the compilation process. This allows the automatic generation of function prototypes to be included in any other modules that use the functions.

(continued)



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The committee has come up against some tough issues.

When using function prototypes, the programmer is no longer forced to have all arguments automatically widened to doubles and ints. When a prototype is present in both the definition and in the file where the function is to be used, the arguments may be specified to be float, char, or even register. This allows greater optimization by the compiler writer and greater control over how information is passed to the function, which is the basic unit in C.

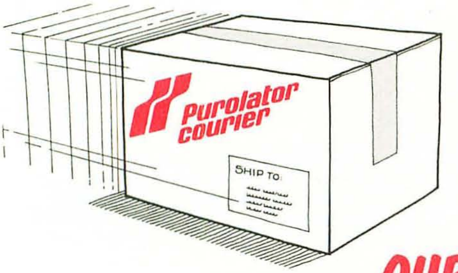
THE TOUGH ISSUES

Over the last year and a half, the Standardization Committee has come up against some tough issues. Various solutions were presented, reports were prepared to educate the members on the pitfalls and plaudits of the solutions, and decisions were made and added to the Information Bulletin. Legwork and elbow grease helped the committee resolve issues such as

- whether the functionality of the enum should be extended;
- what the length of external items should be;
- whether external names can appear in a single case or in both upper- and lowercase;
- how the C language should expand or widen values when evaluating an expression that involves many types;
- how much checking should the compiler do to detect an attempt to change an item declared as type const; and
- whether external items must have a single definition or if they can have many definitions when they are initialized to the same values.

The solutions were arrived at peacefully in an attempt to make the ANSI C language described within the Information Bulletin as usable as possible by the largest set of users. ■

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MACINTOSH EXPLORER

BY OLAV ANDRADE

A disassembler written in BASIC *that lets you investigate your* Mac

AN EXCELLENT WAY to learn how to use a processor's instruction set is to see how things have already been done. The function of a disassembler is to translate machine code to human-readable assembler mnemonics. I know that a disassembler can't aid you in writing good documentation for your own assembler programs, structured code, or any of the aesthetics that a good programmer would consider in writing a program. But if you need to know what is involved in rewriting a particular function for your tastes, or even for a different target machine, a disassembler can help. However, you'll have to keep your wits about you: The reconstituted assembler source is never enough to immediately understand the code; without comments you may find the code's purpose completely obscure.

The target for the disassembler I will describe is Motorola's 68000 microprocessor. I wrote the actual disassembler in Microsoft BASIC for Apple's Macintosh. When I decided that I needed a disassembler, there were no facilities for native compilation on the Mac, but I realized that the many Macintosh Toolbox and operating-system routines (supplied by Apple in ROM) would be a major part of any application. Hence I had to understand how Toolbox calls were made: "How are parameters handled?" for instance. (When I wrote this disassembler, Apple's publication *Inside Macintosh*, which describes these calls, was not available in its final form.) Also, my disassembler didn't need to be fast, since I wouldn't be using it too often; an interpreted language would be fine.

IMPLEMENTATION

A disassembler, as it turns out, doesn't behave too differently from a microcoded processor (such as the 68000). Microcode is a program inside the processor itself that tells the processor what each instruction code should do. In the 68000, the fetched instruction is decoded by a programmed logic array (PLA) to yield a start address in the microcode. You can think of this PLA as a multiway branch in any programming language. In my disassembler, the PLA function is split into two distinct operations: isolating those bits that are important to the decoding (done by performing a bitwise AND to the instruction word using a mask value); and then executing a GOSUB to the appropriate routine. As it turns out, only 30 or so distinct routines are needed to disassemble the entire instruction set of the 68000 processor.

The four data structures needed to implement this scheme are an op-code table and, for each op code in the table, a mask, a match word, and a subroutine identification number. The data for the table itself is presorted according to the number of bits required to uniquely identify the op code. Since those instructions that have no operands (such as nop) have a mask with all bits on (i.e., $FFFF since the 68000 uses a 16-bit op code), they occur first in the table; more flexible instructions occur later in the table (e.g., move.w uses only the first nybble to specify the op code, so the mask is $F000). [*Editor's note: Dollar signs preceding numbers denote hexadecimal notation.*] The scheme employed by the disassembler is to sequentially compare entries in the table with the op

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code until a match is found. (This sequential comparision is the reason for presorting the table by the number of bits in the mask.) A match is indicated when the masked op code is the same as the match word of a particular table entry.

Figure 1 shows the bit encoding, mask word, and match word for the instruction LEA EffectiveAddress,An. If you wanted to decode the word $4BD3, you would perform a bitwise logical AND between the masks in the op-code table and $4BD3 until the result equaled the match word for that op code. In this case, $4BD3 AND $F1C0 = $41C0, where the $F1C0 is the mask for the LEA instruction; $41C0 equals the match word for the LEA instruction. You would therefore deduce that the op code is an LEA instruction and pass it to the subroutine that breaks out its operands. From there it's just a matter of vectoring to the appropriate subroutine by using the subroutine identification number for that table entry.

(a) 0 1 0 0 x x x 1 1 1 x x x x x x

F 1 C 0
(b) 1 1 1 1 0 0 0 1 1 1 0 0 0 0 0 0

4 1 C 0
(c) 0 1 0 0 0 0 0 1 1 1 0 0 0 0 0 0

Figure 1: *(a) Bit encoding of* LEA effectiveAddress,An *instruction. The Xs represent "don't care" bits. For an* LEA *instruction they are used to encode the operands; they may be ignored in determining which instruction is represented. (b) The mask word for the above instruction is formed by filling the word with 1s, except for "don't care" bits in the op code, which are set to 0s. (c) The match word for this instruction is formed by a bitwise* AND *between the op code encoding (with Xs treated as 0s) and the mask word.*

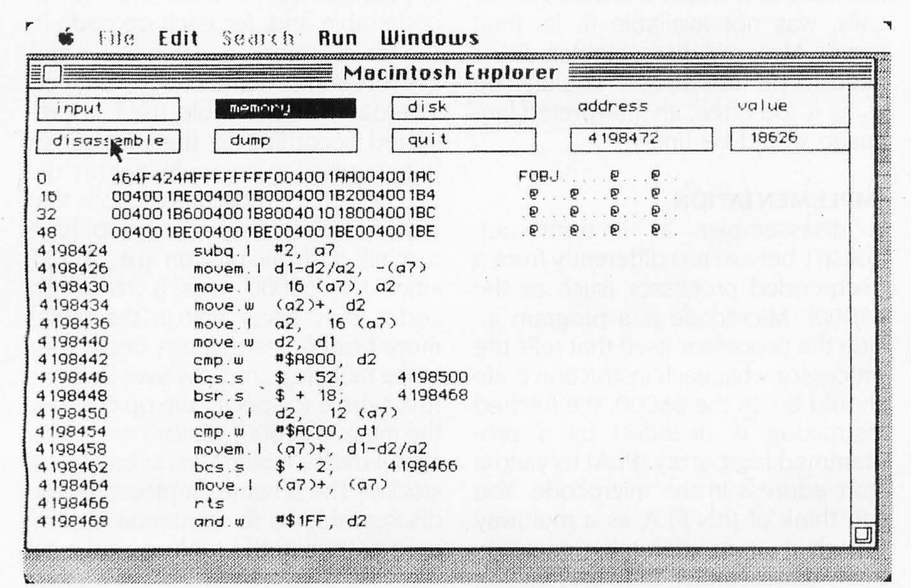


Figure 2: *Shown is the screen of the Macintosh Explorer. Note that the memory path is in reverse video, indicating that it is active. You can see a dump of the beginning of memory and a disassembly starting at address* 4198424.

Another subroutine is used to return a string version of the address mode for those instructions that have flexible addressing modes. Since not all instructions encode the address mode in the same bit positions, this subroutine's caller must break out the addressing mode information and pass it along. This routine also handles the offsets that may follow the op-code word. In double address instructions, as many as four extension words may be required to resolve the address; in any given invocation of this subroutine, only two extension words may be used—and these are passed in as parameters. Boolean variables (actually, BASIC doesn't have any, but they're used that way) indicate whether the extension was used or not. The caller needs to know this so that the next instruction can begin on the correct word, or, for a double address, so that the correct extension words are passed in on the second invocation of this subroutine.

USER INTERFACE

The Macintosh is renowned for its user interface, and this program tries to take as much advantage of that interface as possible. Consequently, a great deal of code is concerned with the state of the mouse. There are three paths of information available to the disassembler, indicated in the top row of boxes: Input, Memory, and Disk (see figure 2). This grouping is intentional and useful because it visually indicates the connection between them. The active path is shown by highlighting its associated box. You change the active path by clicking the mouse button on the desired box. Since it's uncomfortable to change

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A disassembler behaves much like the microprocessor itself.

from the keyboard to the mouse, I've tried to minimize the keyboard input. The address and value box are the only places where keyboard input is required. The address field is for specifying the address where you want to begin the dump or disassembly; the value field is only for use with the Input path active (I'll discuss the value field later).

Both the address and value fields allow either decimal or hexadecimal numbers. The value field is restricted to 16-bit numbers, although you don't get an error message if the field overflows.

The bottom row of boxes is grouped to show commands: Disassemble, Dump, and Quit. Clicking the mouse on one of these will execute the command. Disassemble and Dump each generate one line of output. (Holding the mouse button down generates multiple lines.) The Quit command returns to the system that Macintosh users know as "the Finder." Perhaps this action is a bit drastic, since it may involve an unintentional exit, but I haven't found it to be a problem.

To the user the three paths appear to operate on linear arrays (indexed by the address field). This is done to present a consistent model of the machine—although it means more work for the programmer since the program must take care of details like mapping the disk address to a block address. Also, each path's address "sticks to it." By this I mean that changing the path from memory to disk will change the address (and display that change) to the address last used to read the disk. This allows users to flip between the paths and resume disassembling or dumping from where they left off. This strategy is meant to further reduce the use of the keyboard.

To many readers the Input path will be the mysterious part of this program. It is meant to be used for preassembled code such as that which is made available to BASIC through an array (like that used to perform the disk-sector Read function in this program). By clicking on the Input path and then specifying the address, you will be able to enter the preassembled code through the value box. You can then disassemble or dump it, as you would with the Memory or Disk paths.

The presence of the Input path is the only reason that the value field exists or accepts input. Both the Disk and Memory paths ignore values entered in the value field. Although it would be easy to extend its function to allow editing of memory and disk locations, it is not necessarily useful. The program's central purpose is to present information, not to potentially corrupt the system's integrity.

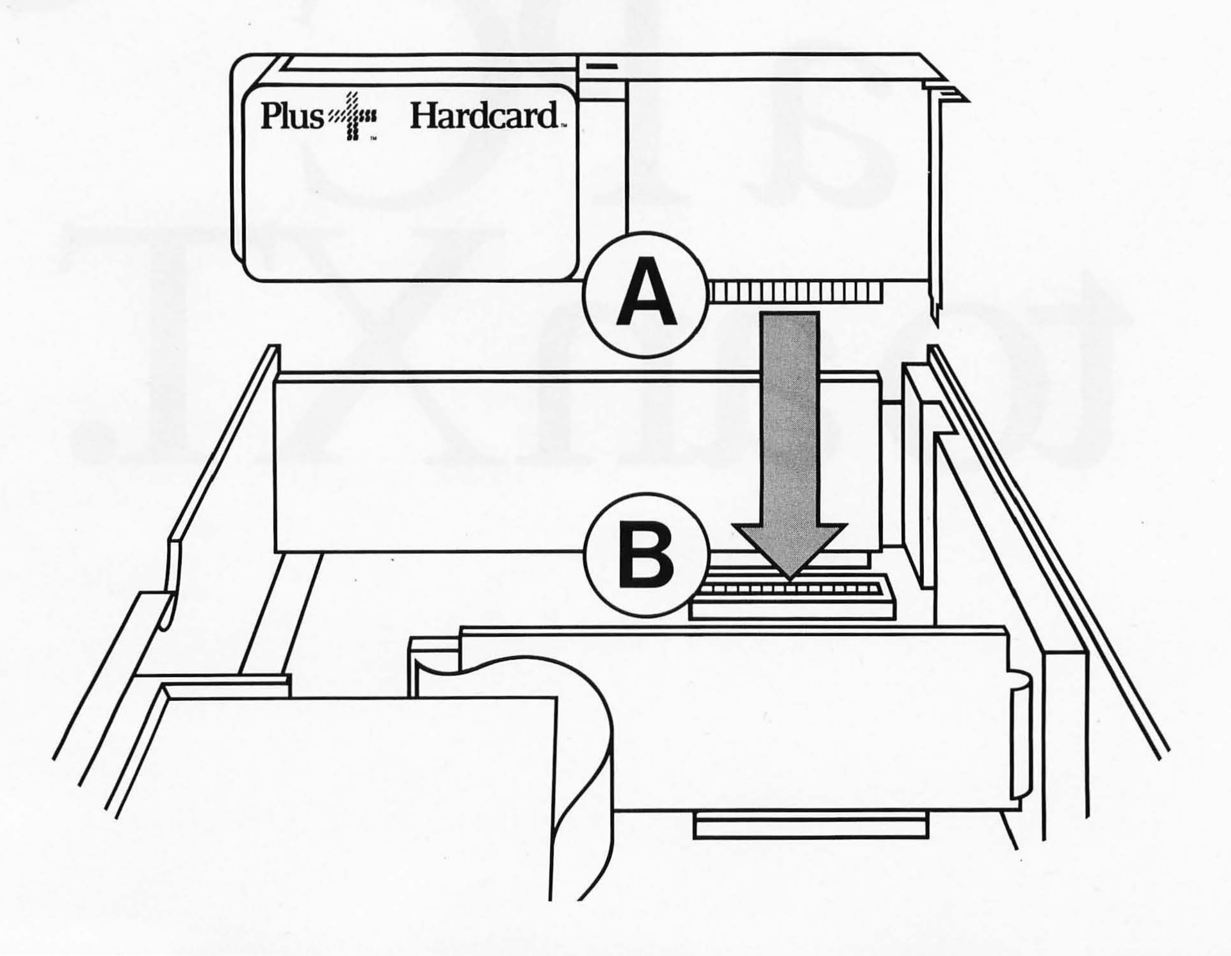
CONCLUSION

Because a disassembler behaves much like the processor itself (i.e., fetching data that is treated as code), the structure of the disassembler can be used to emulate the processor in a different environment. This means that with some work, the Macintosh Explorer can be used as a debugger for the Motorola 68000 processor—and because the program is in BASIC, you don't need that processor itself. So if your plans stray into the area of building a 68000 system, you could use this program on an existing computer to debug the bootstrap routines. Though much of the program is dedicated to making the disassembler almost entirely mouse-driven, it shouldn't be too difficult to use it on any system by replacing the user interface and disk-sector Read subroutines. ■

[*Editor's note: The source code for the Macintosh Explorer is written in Microsoft* BASIC 2.0 *for the Macintosh and is available for downloading from* BYTEnet Listings *at* (617) 861-9764 *and is also available on disk. See page* 358 *for details.*]

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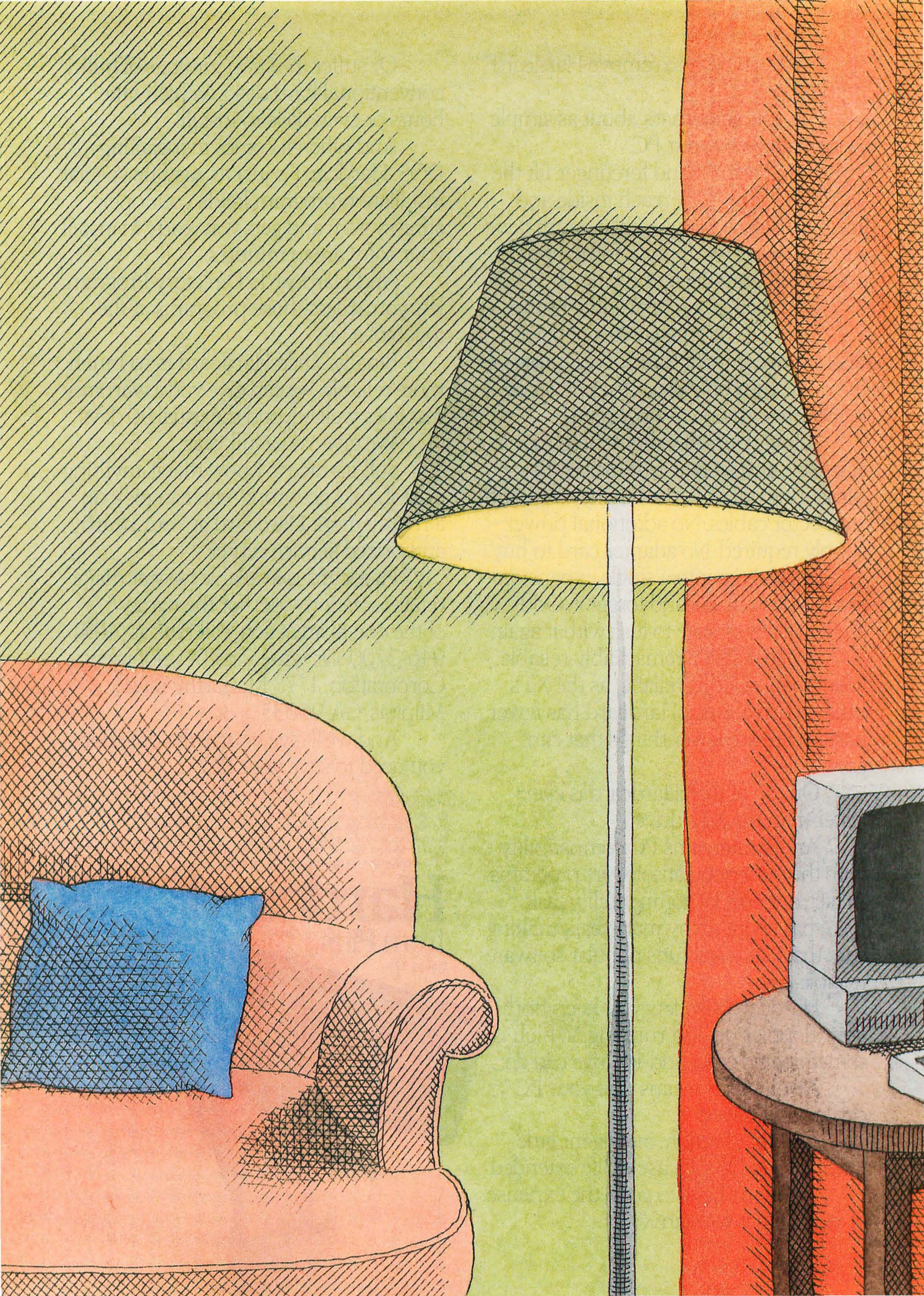
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Homebound Computing

THE WORD HOMEBOUND means exactly that—bound to the home. We have used this word intentionally. This issue is not restricted to computing for the disabled. There are various ways in which a person can be homebound. If you are severely disabled or require special care or equipment, you are considered homebound. If you are elderly, you may also be essentially homebound, although you would not necessarily be considered disabled. If you are the care-giving parent of a small or disabled child, you are homebound a great deal of the time. If you live in a geographically remote or economically depressed area, you also qualify as homebound in your current environment. Finally, if you are bound to your home by choice rather than necessity, that is, if you choose to work at home instead of in an office, you are also considered homebound by our definition.

In this issue of BYTE we have tried to present articles of interest to each of these groups—hopefully, something for everyone. "Working at Home with Computers" discusses various things to consider before you make the choice—if indeed it is a choice and not a necessity—to work at home. Bruce Baker's "Using Images to Generate Speech" presents a fascinating concept borrowed from ancient Egypt; in practical application the article is about a concept keyboard for the speech-impaired that uses images with different meanings in different contexts to generate environment-specific sentences. "The Electronic University Network" by Donna Osgood deals with earning a college degree at home with the help of a microcomputer, not from a correspondence course, but from a fully accredited university. Raymond Kurzweil discusses "The Technology of the Kurzweil Voice Writer," a machine with significant implications for future applications for the hearing-impaired. "Increasing Independence for the Aging" by K. G. Engelhardt and Roger Edwards focuses on the future of robotic aids for the aged and for other persons who are motion-impaired, whether by birth, accident, or disease. While our readership does not include a large number of aged persons, who among us does not one day hope to reach that stage? Finally, Aries Arditi and Arthur Gillman talk about the human factors that must be considered in creating "Computing for the Blind User."

For some of us, being homebound is a fact of life; for others it is a dream. Either way, computer technology provides opportunities and aids that were unavailable a few short years ago. The future can only expand the horizons of those of us who are homebound.

—Jane Morrill Tazelaar, Technical Editor

WORKING AT HOME WITH COMPUTERS

BY JANE MORRILL TAZELAAR

For some, telecommuting is a choice; for others, it is the only option

THERE ARE MANY REASONS for wanting to work at home. Some of them involve disabilities that make it impossible or impractical to work in an office. For many disabled persons, the alternative to working at home is no alternative at all; it is the only work they can do, the only way they can become productive members of the work force. Some people work at home because of priorities such as being available to young children, especially during the preschool years. Many parents of small children must choose between sending them to daycare centers or babysitters and earning a reasonable living. Other reasons involve the lack of local work opportunities in economically depressed or geographically remote areas. And for some people, working at home is a simple matter of choice. The electronic cottage, the flexiplace, telecommuting, worksteading, or whatever you wish to call it could be the answer to all these problems.

STARTING YOUR OWN BUSINESS

Starting your own business seems to be the answer for many people. There is a certain romance in the very word entrepreneur, and there is a great deal of information available to help you get started if the idea of being one appeals to you. The various organizations associated with the cottage industry movement—the Association of Electronic Cottagers, the National Association for the Cottage Industry, and the National Alliance of Home-based Businesswomen—offer good and helpful information for the aspiring entrepreneur. (See the text box "Sources Mentioned" on page 156 for addresses and phone numbers.) They also offer countless references, contacts, and, possibly most important, support groups.

Two subjects seemed to jump out at me from all the literature I have seen on starting your own business: selling and networking. First, if you don't want to sell, you probably don't want your own business. Most business ventures involve direct selling. Whether you provide a product or a service, you need to sell it. Even if you have salespeople working for you, you have to sell the idea to some financial institution to get funds to get started and to the people you hire to get them to work for you. Then, long after the basics are in place and you are operational, you'd better be prepared to talk about your product or service, explain its value, and convince a prospective buyer that he or she ought to do business with your company instead of someone else's—in other words, sell.

Networking is a way to increase your contacts. Whether people are business contacts or social contacts or both, they can add significantly to the success of your business. The people you know either personally or electronically are sources that can provide you with future customers, business partners, financiers, good tax accountants, awareness of your competition, discounts on computing equipment, the inside story on future technology, and so on.

Starting your own business is a very rewarding venture for some and a complete disaster for others. At the

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very least, you should make sure you enjoy what you are going to be doing before you enter the world of the entrepreneur, because you will probably be doing a great deal more of it than you think.

Then consider the advice of some successful trailblazers who have done the dirty work and found out what is necessary the hard way. It is nearly impossible to foresee at the outset all the complications involved in having your own business. *Working from Home* by Paul and Sarah Edwards (Jeremy P. Tarcher Inc., 1985) is a good book that covers the many steps involved in setting up a business and arranging your life to handle it. *Women Working Home* by Marion Behr and Wendy Lazar (WWH Press, 1983) contains a number of examples of home-based businesses (not all computer-related) and provides a sizable directory of contacts organized on a state-by-state basis. There are many more sources available. The various cottage industry groups can lead you in the right direction.

WORKING AT HOME FOR SOMEONE ELSE

As exciting as starting your own business sounds to some, it is not for everyone. The difference between starting your own business and working for someone else is not a question of talent, intelligence, or personality. It is rather one of desire, time, and priorities. Working at home for someone else doesn't inspire the volumes of written material that entrepreneurship does. The romance doesn't extend to the worker; however, *finding* such home employment is easily as creative a project.

Where do you look? Whom do you contact? Will personnel officers think you're crazy even asking? What kinds of positions exist? Can you convince your current employer to try it? It's not an easy task, and if you are disabled or caring for small children, it can be even more difficult. There is help, however. The various cottage industry associations, while they do not stress this area, do offer some resources. In particular, the National Association for the Cottage Industry provides a list of 49 companies currently using telecommuters. Many of these are national companies, and while only those locations mentioned on this list are currently involved, I would assume other local offices of those companies would be good possibilities.

Another contact is Gil Gordon of Gil Gordon Associates. His consulting firm specializes in working with companies to set up telecommuting programs. He has general information on telecommuting and publishes a newsletter on the subject. He does not, however, maintain lists of companies. Gil sells an audiocassette entitled "How to Get a Job Working from Home: Telecommuting and Other Options." The Association of Electronic Cottagers describes it as outlining "how to keep your paycheck while working from home, including the best industries to approach, what companies are hiring at-home workers and how to convince your boss to let you work at home."

Electronic networking can be as important to the home-based employee as to the entrepreneur. You need to keep yourself up to date on new developments in the industry, and what better way than to tap in electronically to a whole community of people involved in your field? Bulletin-board systems provide this opportunity. For the at-home worker more than others, this contact can provide the kind of interaction, both business and social, that occurs on coffee breaks and casual lunches for the office worker. It can also provide a support group of other people who share the problems and pleasures of working at home. One such electronic support group is the Work-at-Home Special Interest Group on CompuServe. (You locate it by entering GO HOM 146.) The Source and BIX also provide good electronic contacts.

SOURCES MENTIONED

THE ASSOCIATION OF ELECTRONIC COTTAGERS
677 Canyon Crest Dr.
Sierra Madre, CA 91024
(818) 355-0800

BIX
BYTE Magazine
70 Main St.
Peterborough, NH 03458
(603) 924-9281, ext. 131

COMPUSERVE INFORMATION SERVICES
5000 Arlington Centre Boulevard
Columbus, OH 45220
(800) 848-8990

GIL GORDON ASSOCIATES
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Monmouth Junction, NJ 08852
(201) 329-2266

THE NATIONAL ALLIANCE OF HOME-BASED BUSINESSWOMEN
POB 237
Norwood, NJ 07648

THE NATIONAL ASSOCIATION FOR THE COTTAGE INDUSTRY
POB 14460
Chicago, IL 60614
(312) 472-8116

THE SOURCE
1616 Anderson Rd.
McLean, VA 22102
(800) 336-3366

THE CURRENT DEBATE

There are two sides to the telecommuting issue. The AFL/CIO is definitely opposed to the current trend toward working at home with computers. This is not a matter to be taken lightly. The AFL/CIO, a powerful organization, has asked the U.S. Labor Department for a ruling against doing computer work at home (see reference 1). The organization raises some important issues: assuring the payment of at least minimum wage, protecting employee fringe benefits, and guaranteeing the right to organize in order to deal with unreasonable employer demands.

Undoubtedly, we all have our own biases: for or against working at

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home, for or against the union argument, for or against federal intervention in that portion of our lives. But the fact remains that there are valid points on both sides. If the legal outcome of this issue favors working at home, some protective provisions will have to be made so that telecommuters will not be exploited. If the outcome favors the union argument, some exceptions will have to be made to allow severely disabled persons (and perhaps other individuals) to support themselves by working at home.

State and Local Regulations

Many states have laws on their books that relate in one way or another to working at home. Most of these regulations are left over from a pre-electronic era. In fact, a January 1985 report on these state regulations by Electronic Services Unlimited notes, "ESU found *no current state regulations directly prohibiting company employees from working at home as teleworkers*. . . . In fact, five states [Iowa, Virginia, Delaware, Kansas, and Minnesota] have passed resolutions *endorsing* work-at-home, and a sixth, New Jersey, has introduced such a resolution." (See reference 2.) However, there is at least one reported instance of a zoning department using zoning restrictions on operating a business in a residential area to prohibit working at home on a home computer (see reference 3). Farfetched? Maybe, but true.

ESU goes on to say, "If there is any reason to be concerned with [current] state regulations. . . it stems from the possibility that unions, lobbying against telework as a potential modern equivalent of the sweatshop, may attempt on a state-by-state basis to extend the traditional laws to include prohibitions against telecommuting. It is certainly easier to attempt to extend current laws than to try to establish an entirely new set of anti-computer laws." (See reference 2.)

The legal argument is still in its infancy. Some states have dealt with telecommuting on a legislative level, but the question is far from answered. Many of us aren't even sure what the

Many states have laws that relate to working at home.

question is. For instance, if you earn your living at home on your computer or on a workstation electronically connected to your employer's computer, we could probably agree that you would be affected by laws related to working at home. However, if you work with computers in an office and use your home computer to connect to a bulletin-board or conferencing system on which you discuss various computer-related subjects, would work-at-home laws apply to you? Most of us would probably say no. However, this question may not be left to us to decide.

CONCLUSION

The availability of considerable computing power in home computers has opened the door for new groups of people to enter the work force. Many of these people would have been unable to support themselves in another time. Many of these minds would have gone untapped in an earlier age. Freedoms once embraced are hard to give up, and telecommuters and those who dream of being telecommuters will not relinquish the freedom to work at home easily. Perhaps a compromise will be reached that will allow those who need or wish to work at home to do so while maintaining the worker protections so hard won by the labor movement. ■

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2. "State Regulations on Work at Home." *Telecommuting Research Program Memorandum #2*. New York: Electronic Services Unlimited, January 1985, pages i–ii.
3. "Computer Shock! City Calls Home-Work Illegal." *The Chicago Sun-Times*. August 28, 1983, page 2.

USING IMAGES TO GENERATE SPEECH

BY BRUCE R. BAKER

Semantic compaction lets speech-impaired people quickly and effectively communicate in a variety of environments

Using graphic images to express meaning is a very old idea; the first writing systems of which we have any extensive knowledge were pictorial in origin. Recently, graphic images have been used to represent certain concepts on computer systems. However, these images are not used as hieroglyphics were—that is, linked together to make sense in sequence. For instance, the Egyptian hieroglyph in figure 1 means "scribe" and contains a combined palette, water bowl, and brush holder beside a seated man. The Egyptians selected these images from a "lexicon" of standard symbols and combined them to form a single idea.

Another difference between ancient and modern iconic graphics is that modern computer icons have used a unique image to represent each unique meaning while ancient writing systems used one image to represent different ideas in different contexts. For instance, the Maya hieroglyph for "shark" in figure 2 also represented "sea." That same glyph in another place meant "green" (because the Maya thought of the sea as green). Since the image indicated "green," it could also mean "jade" when the context was appropriate.

Bruce R. Baker *is the president of* Minspeak Corporation *(840* Rolling Rock Rd., Pittsburgh, PA *15234). He invented the concept keyboard. Bruce did his undergraduate and graduate work in classical languages and linguistics and is currently a consulting linguist for* Prentke Romich Company *and the* Westinghouse Electric Corporation.

MULTIPLE MEANINGS

The multiplicity of meanings employed in ancient writing systems should not surprise us. Spoken language has always behaved in this way. No one ever confuses "blue" and "blew" in speech. They sound the same, but their meanings are obvious in context. Using this concept of multiple meanings, early writing systems could express a large number of specific ideas without resorting to thousands of ideographs.

I explored this natural tendency toward polysemy (multiple meanings) while working on improving the communication rate of people with severe neurological damage. More than a million people in the United States alone cannot speak or use handsigns. Strokes, cerebral palsy, and Lou Gehrig's disease are common causes. Many of these people have full minds; they are just physically unable to express themselves. Spelling and abbreviation systems had been set up to help them communicate, but most of the systems were ineffective because the disabled user had to make a dozen or more inputs to output a single sentence. Complicated number and letter codes also existed, but it was often difficult to remember what had been encoded and how it should be retrieved.

Speech-impaired people need a more powerful information-transfer technique. In an effort to meet that need, I developed a concept keyboard that, while it uses a limited number of images, has the capacity to define whole sentences in five or fewer keystrokes through a technique called *semantic compaction*. The system is commercially implemented with a speech-synthesis device to provide

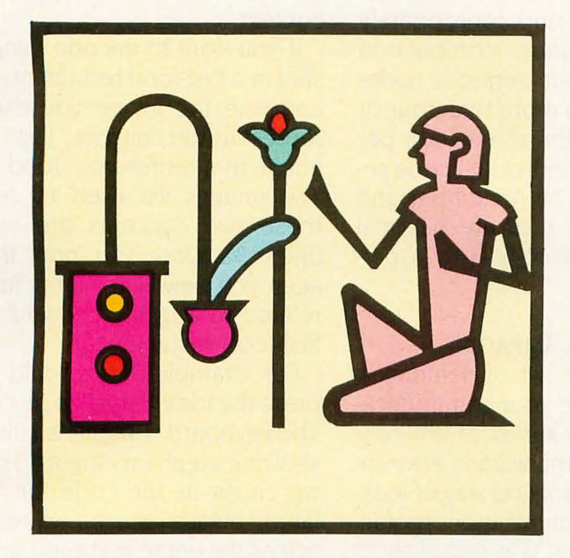


Figure 1:
An Egyptian hieroglyph meaning "scribe."



Figure 2:
A Maya hieroglyph of multiple meanings including "shark," "sea," "green," and "jade."

voice output. (For examples of the technique in use, see the text box "In Practical Application" on page 166.)

The system does not use any particular set of graphics; rather, it provides a method for using graphics in a multiple-meanings setting. Naturally, some types of icons are more appropriate to the technique than others.

While the original work has been applied to the development of a disability aid to facilitate communication for the speech-impaired, the system lends itself to other applications as well. One is a hand-held language translator; another is a smart front end for expert systems and databases.

USING SEMANTIC COMPACTION

If you want to set up a semantic-compaction system for a specific use, you should first make a list of those topics or semantic features that you want to be able to express. A semantic feature is a concept underlying the meaning of a word. Sometimes a single word can represent different semantic features. For example, the word "new" can express at least two semantic features depending upon your intent. If you said, "He has a new car," you could mean either that the car was factory-fresh or that it was recently purchased.

In order to represent natural language for the disability aid, I drew up a list of some 250 semantic features and general topics. With the help of some people who were actually going to use the disability aid, 50 central semantic features and topics were selected to be represented by an illustration of an everyday object or action. For example, we chose to represent the semantic feature "insufficiency" with an umbrella to illustrate "under," a concept linked to that feature for English speakers. The list was examined for at least five other meanings that could easily be associated with that image without further illustration. Weather was one; need was another; protection, a third; and so on.

When we had represented 50 concepts by various common images taken from daily life, we found that 200 other features and topics were also well represented. It is not difficult to encode sentences with only 50 images, but it does take a certain frame of mind. You cannot be afraid of puns, and you have to approach the task with a certain eclectic abandon. You write a wide range of sentences that express the routine needs and thoughts of your day-to-day living. This kind of list has hundreds of items but is not as extensive as you might think. You need to be careful to include only those sentences that you would actually need or use in real life and not add those you might use in a purely hypothetical circumstance.

If you are designing a list for (and with) someone who hasn't been taught how to spell, that skill should not be required for them to use the disability aid to communicate. First, you generate a sentence in your mind and then type it, letter by letter, into the communication aid's keyboard, where one of your images has been superimposed on each number and letter. Then you select from one to several images from the keyboard to summarize the sentence (as concisely as possible). After you have en-

(continued)

ILLUSTRATED BY CHRIS SPOLLEN

coded the sentence, you need to strike only the designated code (or sequence) to output the whole sentence.

There is always a trade-off between specificity and fluency. Your group of encoded sentences would probably not contain the sentence "I don't like broccoli and mushroom casseroles," but you would want "I'm sorry, I don't like that." The art of choosing what to encode often lies in minimizing specificity to maximize fluency. Often, you can do this by making sentences applicable to a variety of verbal and physical contexts. "That is not what I meant" is a more widely usable sentence than "That is not what I meant to order." You can use the first sentence to deal with any misunderstanding, while the second sentence applies only to one in a place of business.

A sentence vocabulary of 700 to 1000 entries can go a long way toward enabling a speech-impaired person to communicate, provided those sentences are quickly and appropriately accessible. Semantic compaction allows this because its sentence codes are very short—no more than four or five images (and therefore keys) per sentence—and its individual code sequences are easy to remember and generate because they are pictorial reminders that are logical to a particular user.

Environmental Impact

To compose your list of sentences, you need to divide your communication needs into a series of environments. These communication environments provide a practical way of looking at your communication profile. The code or codes you establish to define a communication environment are the initial element or elements in a sentence sequence, and you can use a special power key to lock in the initializing environmental code. Each sentence you initiate while an environment is locked in is interpreted in that context.

If you want to encode things to be said in a fast-food restaurant, you can combine the image you choose to represent the concept "fast" with an image that represents "food" to you. The images we used to represent these two concepts are shown in figure 3a. Once you input these images, you view all the other images as related to things you might say in a fast-food restaurant.

For example, how would you express the idea "large" in this context? The keyboard contains an illustration showing elephants (figure 3b), which we chose as the code for "Make it large, please." If you were to look across the entire keyboard with all the available images, dozens of sentences would now suggest themselves; in fact, you could incorporate the menu of any restaurant into the semantic map. You can encode "I would like a Coke, please" by adding the icon in

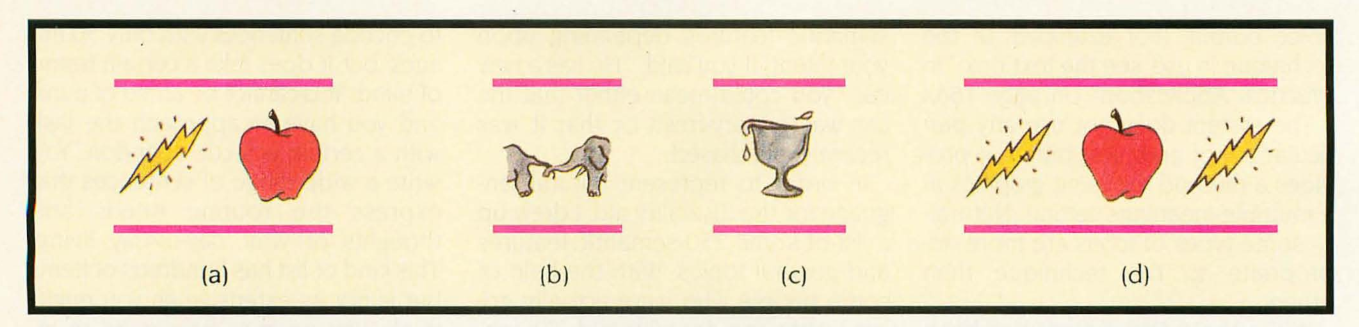


Figure 3: *Possible concept codes for a fast-food restaurant: (a) represents one possible environment-code sequence appropriate for that environment, (b) could mean "large," and (c) could be used to order a Coke. The computer sequence shown in (d) could be used to order french fries in a fast-food restaurant; it consists of the environment code followed by a code you might choose for french fries.*

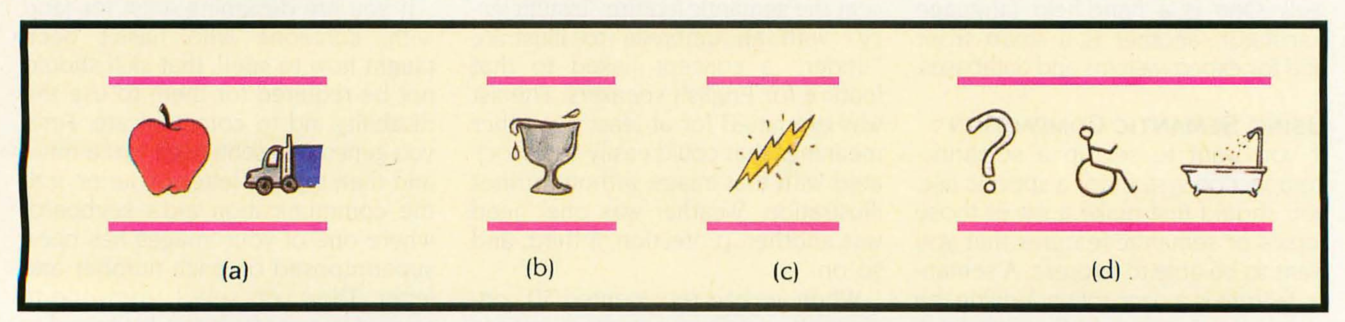


Figure 4: *Possible concept codes for a service station: (a) could represent the environment code, while (b) might mean "Fill it up" within that environment, (c) might mean "Please check the battery," and (d) could be used to ask the question, "Is your bathroom wheelchair-accessible?"*

figure 3c to the initializing environment code (figure 3a).

What would you choose to represent a desire for french fries? To many people, the yellow lightning bolt already used as part of the fast-food environment code also resembles a french fry. Thus, figure 3d forms a sequence that could represent "I would like some french fries."

A service station is another common communication environment. For the environment code, you might choose the apple for food or fuel and the truck for transportation (see figure 4a). Now each symbol on the keyboard relates to something you might say in a service station. What could the cup running over in figure 4b symbolize? "Fill it up" is the choice of many people. The lightning bolt in figure 4c could be used for "Check the battery, please." Just as for the fast-food environment, all the images on the keyboard now relate to the central theme or environment: things to be said in a service station. What might figure 4d mean in this environment? For many users, this sequence means "Is your bathroom wheelchair-accessible?"

You can select as many different communication environments as you wish or need. A college student might want to have a set of sentences describing religious or political views. Figure 5 could be the environmental lock-in code for discussions about scholarship money. The topics, or environments, are limited only by your imagination and, practically speaking, your communication needs.

AN ASSOCIATION OF ONE

The technique is an associational one, and no one but you need understand the meaning of the sequence. Different sets of images meet the needs of people of different ages and in various states of cognitive development. You, as the system user, select those codes that are appropriate to you for the sentences that are also appropriate to you. If necessary, a therapist or family member can enter the sentences and codes you choose

(continued)

into the system. Anything that you associate with the pictorial or ideographic aspects of an image is fair game. The code is established as a communication between you and the machine, not between you and someone to whom you wish to speak.

This technique would be purely mnemonic if memory were the only mental facility involved. However, this technique relies on association as well. What you associate with a given image today, you are likely to associate with that image tomorrow. This principle is frequently the basis of psychological tests. You do not so much *remember* the sequences of images as you *reassociate* them.

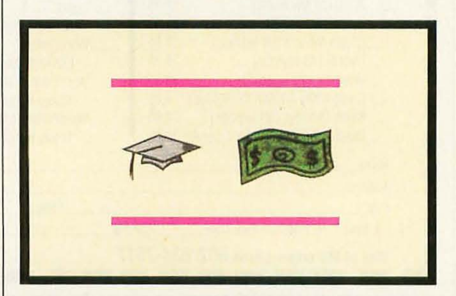


Figure 5: *A possible environment sequence for discussions of scholarship money.*

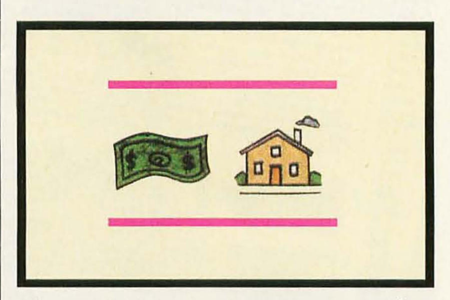


Figure 6: *An environment sequence that might represent a bank.*



Figure 7: *If you use semantic compaction to produce individual words instead of sentences, this image of a telescope might be used to generate the word "look."*

It is not enough to be able to remember how you encoded a sentence; you have to know that you have such and such a sentence at hand. As your eyes scan the various images on the keyboard, you perceive a gestalt. If you are thinking in terms of fast food, each image serves as a prompt to remind you of what you have stored in that environment. Another gestalt occurs as you scan for the environments you programmed. If you set up "money" and "house" (see figure 6) to mean a bank, your mind is alerted that this environmental code sets up certain sentences.

In the examples shown, the codes themselves have been brief. Owing to the special power key used to lock in the environment code, you can express fairly long and often quite specific sentences with a single key. Polysemy is the generating linchpin of a usable concept keyboard. In this article alone, the lightning bolt has been used to mean fast, french fries, and a car battery. Without polysemy the number of symbols you would need to represent all the ideas and topics about which you would want to communicate becomes too large.

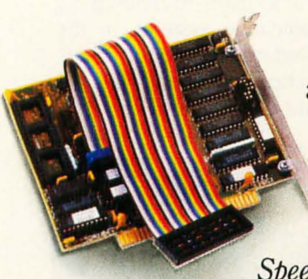
The two salient characteristics of semantic compaction are, first, a limited number of graphic images and, second, very short codes to represent the unique items held in the database. Semantic compaction achieves these economies by using the human mind's ability to understand context, a feat as yet fairly difficult for machine intelligence.

Individual Words

The most efficient way to use semantic compaction is to have it output whole sentences, but you can use the technique to output words as well. Even in this, semantic compaction is more efficient than abbreviation systems that rely on spelling, and it develops better syntax for the developmentally disadvantaged while giving you a real opportunity to com-

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pose your own sentences with word elements that you can readily learn to manipulate.

The system works by assigning a single word meaning to each symbol on the keyboard. For instance, you might choose to assign the symbol of a telescope shown in figure 7 to the word "look." To do this, you assign to a key at the top of the keyboard the meaning "Verb" or "Action." The adjoining key bears "Verb+s" or

In Practical Application

Jenny Lowe is pictured using Minspeak (a commercial product using the semantic-compaction technique) in a device called Light Talker by Prentke Romich (see photo A), which was prescribed by her speech pathologists at the Pioneer School in Pittsburgh. (Prentke Romich has leased the exclusive use of the Minspeak patent protections for the disability industry until 1989.) This device became available in the summer of 1985. It is called Light Talker because its front panel exhibits 128 LEDs (light-emitting diodes), each of which emits a beam of infrared light that is read by the optical wand worn by Ms. Lowe. When the wand is in optical rapport with a specific diode for a user-specific amount of time, the device reads it as a keystroke. The panel can have as many as 128 such keys or as few as 8. You make your key selections either directly or indirectly by scanning if your disability makes it difficult for you to point with your head, hand, or foot. Many people with Lou Gehrig's disease, cerebral palsy, or head injuries can operate only single switches or joysticks with ease and accuracy.

Consequently, you can access the Light Talker with a variety of switch interfaces including the optical headpointer, brow-wrinkle switch, rocking-lever switch, pneumatic switch (sip-puff breath switch), air cushion, joystick, and arm-slot control. The selection of the desired operating mode is simple: You depress the Light Talker's On button for 10 seconds, then a menu of possible operating modes appears, one mode at a time, on the two-line LCD (liquid-crystal display) each time you depress the On button. There are 25 different entry modes possible. Among them are 128- and 32-key row-column scanning, 8-key count scanning, two- and three-switch-entry Morse code, and five-switch directional scanning. Speech pathologists, occupational and physical therapists, and physiatric medical doctors can all have input into the appropriate mode and switch selection for an individual. When the optimal mode and switch have been determined—often through trial and error—you can connect the desired specialized switch to the Light Talker through a standard RS-232C interface.

Prentke Romich's Touch Talker (see photo B) is another realization of the Minspeak technique. It is somewhat smaller than the Light Talker, weighs about five pounds, and uses touch to activate 128 membrane switches embedded on the front panel. Specially attached front panels can configure the system with only 32 or as few as 8 touch-sensitive areas. Photo C shows a Touch Talker being used by Tony Miralles, M.S.W., one of United Cerebral Palsy's professional staff members in Pittsburgh, who has cerebral palsy. In this photograph the Touch Talker interfaces to a printer for use not as a voice communicator but as a means of lowering the number of keystrokes required to write a social history of a client. You can mix grammatically oriented labels with the multimeaning icons to generate texts that require radically fewer key selections per word.

Both devices use Street Electronics' Echo II speech synthesizers and store up to 1526 sentences averaging 25 characters each. They come supplied with a set of 100 symbols that have proved helpful to users in developing their communicative systems in the past. Blank overlays are also furnished, as are instructions and materials for designing your own symbol set.

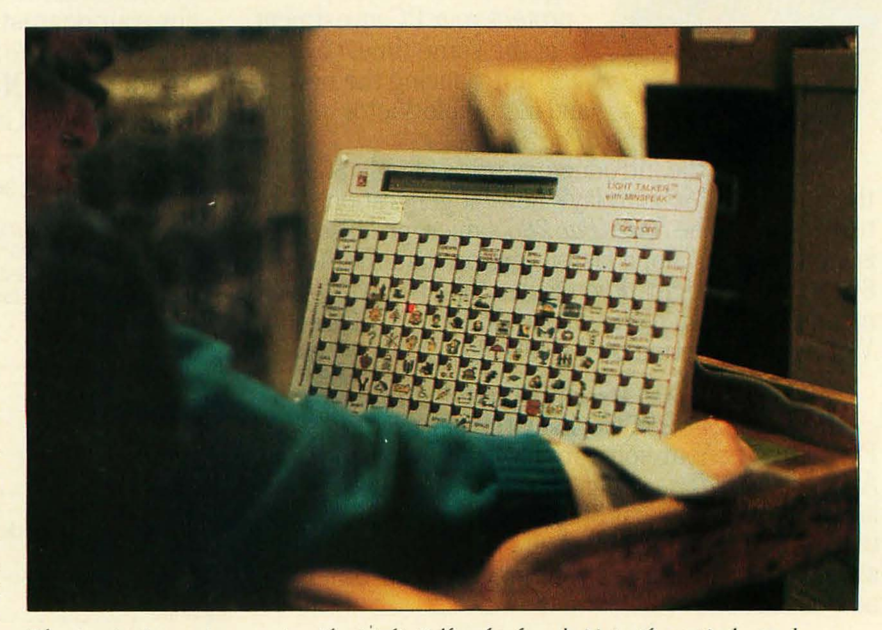


Photo A: *Jenny Lowe using the Light Talker keyboard. Note the optical wand Ms. Lowe is wearing and the lighted diode on the keyboard. When light contact has been sustained for a user-definable length of time, the keyboard interprets the contact as a keystroke.* (*Photo by Robin Schwartzmiller.*)

"Action+s." The next key is inscribed with "-ing." The sequence of "Verb" followed by the telescope image outputs "look," while that of "Verb+s" and the telescope outputs "looks," and the sequence of "-ing" plus the telescope outputs "looking." An ac-

(continued)



Photo B: *The Touch Talker keyboard. Note the keyguard to prevent those with motor-coordination difficulties from activating the wrong key. This device also requires a pressure of 4½ ounces to initiate a keystroke, enabling those who have problems controlling fine movements to select only the key they really want.* (*Photo by* Robin Schwartzmiller.)

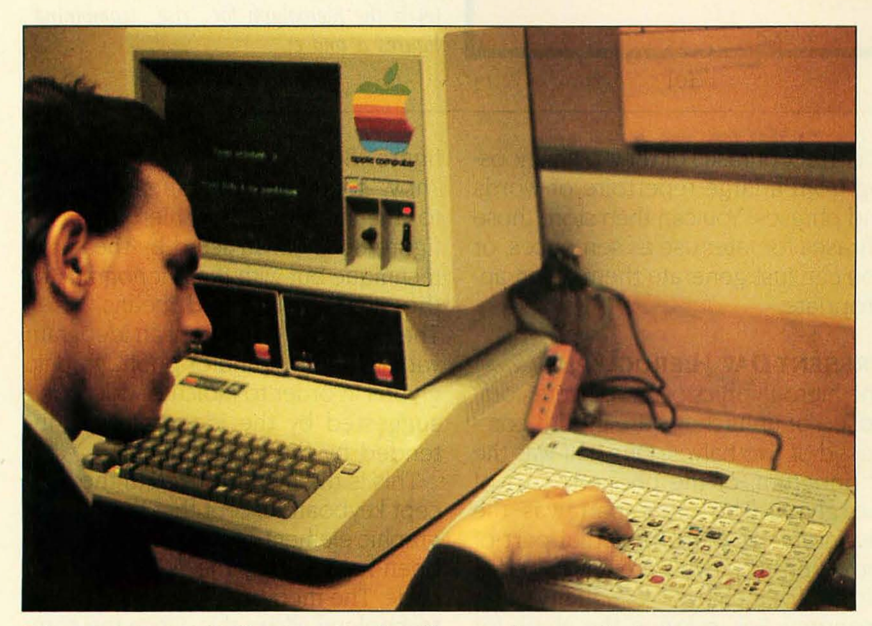
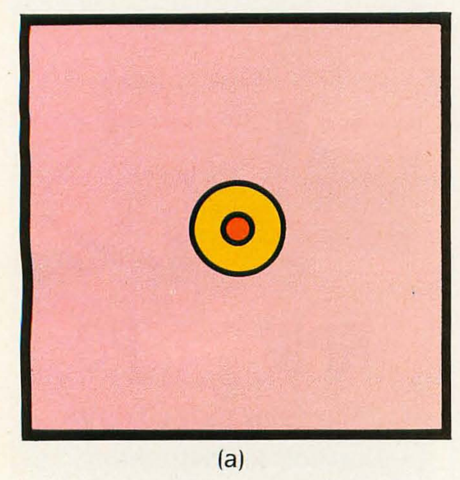
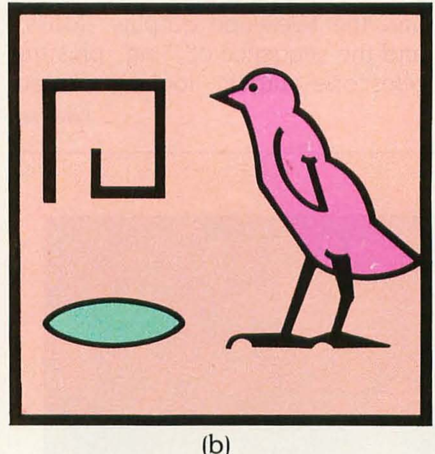


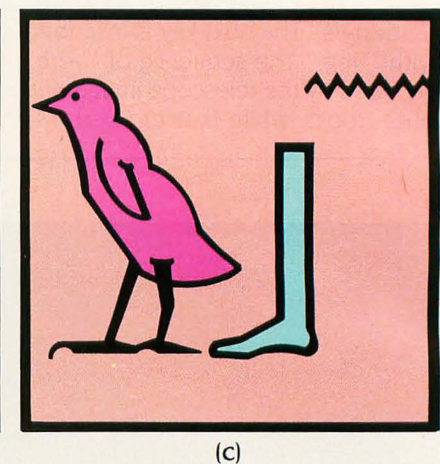
Photo C: *Tony Miralles using Touch Talker. In this case the keyboard is not being used to generate speech; it interfaces with the computer to lower the number of keystrokes required to enter information.* (*Photo by* Robin Schwartzmiller.)



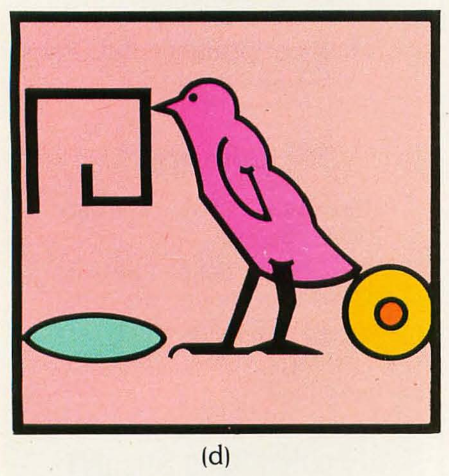
(a)



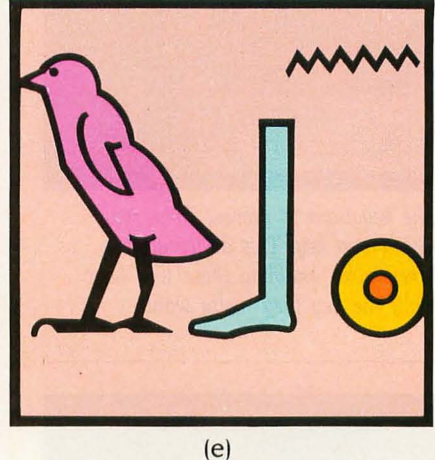
(b)



(c)



(d)



(e)

Figure 8: *The following are various Egyptian symbols:*

(a) is the glyph or ideogram for "sun,"

(b) is the phonogram for the sound "hrw,"

(c) depicts the phonogram for the sound "wbn,"

(d) shows the Egyptian hieroglyph for "day" (a combination of figures a and b), and

(e) is the hieroglyph for "rise" (combining figures a and c).

tion word that can readily be associated with each image on a concept keyboard is coordinated with simple grammar keys. This gives you 50 or more action words—in their correct form—at only two strokes per word.

The next step is to assign a key at the top of the keyboard the value "Noun" or "Thing." Another key is labeled "Noun Pl." or "Thing Pl." Then you assign to each image the meaning most appropriate for it. This gives you 50 nouns you can use in sentence composition.

You can repeat the foregoing steps for as many parts of speech as you desire. If you exploit the system to its fullest potential, you can represent many hundreds of words on the keyboard. By this process, even nonreading users can assemble grammatically correct phrases of their own choosing from a large repertoire of words and phrases. You can then store those phrases for later use as sentences, or you can just generate them when appropriate.

PRESENT-DAY HIEROGLYPHS

The hieroglyphics of Egypt were composed of units that were in turn composed of two halves. One half was the phonogram, or the phonetic part of the glyph. The other part was the ideogram, or the conceptual part of the glyph. The two were combined in order to achieve specificity and economy. For instance, the glyph for "sun" in figure 8a suggests various ideas to the mind. Figures 8b and 8c are phonograms that represent the Egyptian sounds "hrw" and "wbn," respectively. Thus, the hieroglyph in figure 8d combines the Egyptian "hrw" sound with the "sun" ideogram to mean "day." The hieroglyph in figure 8e is constructed by the same technique but with the phonogram for the "wbn" sound and means "rise." The Egyptians combined an ideogram with different sound or phonographic glyphs in order to indicate which idea suggested by the ideogram was intended by the writer.

This is the method used in the concept keyboard except that the phonographic element of the hieroglyph has been replaced by the environmental code. The memory of semiconductor technology allows this. Since the computer remembers the details, we can discard the more exacting and inefficient phonetic components and enter into a totally ideographic man-to-machine interface. ■

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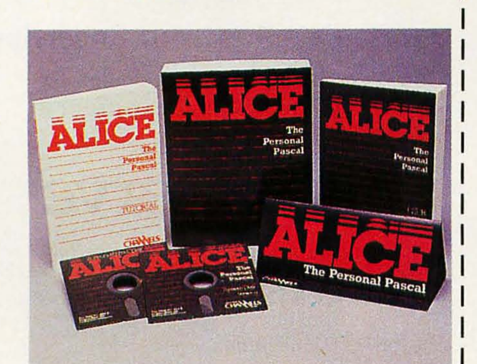
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THE ELECTRONIC UNIVERSITY NETWORK

BY DONNA OSGOOD

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UNTIL RECENTLY, education at home meant correspondence courses. Taking courses through the mail is a slow, cumbersome way to learn, and for many people it means missing out on a vital part of the education experience: contact with a human instructor. Without that, you can easily lose interest in the course and drop out.

Meanwhile, as the baby boom generation passes, colleges faced with declining enrollments are looking for ways to reach a wider range of potential students. They need to reach people who would not ordinarily be willing or able to matriculate in the traditional way.

TeleLearning's Electronic University Network addresses both problems. Through the Network, universities offer accredited courses to students who enroll, participate in "class," interact with instructors and other students, and take tests on the material they have studied, all without leaving their microcomputers. Since classes are small (usually 10 students per instructor) and feedback on each assignment comes within a day or so, students taking courses from colleges through the Electronic University Network get much more individual attention than they would in a large class on campus. Some of the other benefits of telecommunication apply here as well: An instructor can judge a student only on the basis of his or her work, without interference from preconceived notions and biases based on how the student looks, speaks, or acts.

Founded in 1983, TeleLearning began offering accredited courses in March of 1984. In January 1985 it established full-fledged degree programs, and it now offers two associate degrees, two bachelor's degrees, three MBAs, and specialized professional certificates. The degrees are awarded by fully accredited colleges (Thomas A. Edison State College in Trenton, New Jersey, City University in Bellevue, Washington, and John F. Kennedy University in Orinda, California). The Electronic University itself offers no credit, acting solely as a coordinating medium and resource center for students. About 17,000 students have enrolled.

Courses available through the Electronic University Network include noncredit courses for personal improvement (writing, computer literacy, drawing, and wine appreciation, for example), business and professional skill classes (time management, accounting, and business math, among others), and tutoring programs for children (reading, math, and computer literacy). Courses for credit span the humanities, natural sciences, mathematics, social sciences, and business at undergraduate and graduate levels.

HOW IT WORKS

You enter the Electronic University by buying an enrollment package for $150. This one-time fee covers operating software, communications software, and lifetime enrollment in the Electronic University for your entire family. Tuition for individual classes is handled separately. The admissions questionnaire and class registration

(continued)

Donna Osgood is an associate technical editor for BYTE. She can be contacted at McGraw-Hill, 425 Battery St., San Francisco, CA 94111.

can be completed on line. When you sign up for a class, the University mails you a textbook, study guide, and course disk.

Currently, undergraduate tuition is $180 per course, while graduate courses are $200. Connect time is included in course fees.

HARDWARE

TeleLearning software is available for the IBM Personal Computer and PCjr, Apple II series, and Commodore 64. According to Ron Gordon, president of TeleLearning, 35 percent of the Electronic University's students did not own a microcomputer before but bought one in order to take classes. Any student who doesn't already have a modem can buy one from TeleLearning.

COUNSELING

If you choose to pursue a degree program through the Electronic University, you consult one of TeleLearning's counselors. The counseling services go beyond those of a traditional admissions counselor. Counselors help students pick a school suited to their needs and design appropriate curricula, incorporating courses from participating colleges, classes taken on campus, and proficiency exams. The TeleLearning counselor who helps you choose courses or design a degree program also follows through with periodic progress checks and is always available to answer questions and offer guidance. In fact, the counselor will keep tabs on your progress in a particular course ("Have you finished lesson 4 yet?"), but only if you request that sort of handholding.

TAKING A CLASS

A typical lesson in a credit course begins when you boot up the course disk and receive an assignment, perhaps chapters in a text to read and workbook sections to complete. After doing this work you go back to the disk to work through the exercises that accompany the lesson. This may include an overview of the sections

(continued)

you've just read, with a series of exercises designed to make you think about the lesson in as many ways as possible. Some of the ideas presented in the reading may be covered in more depth at this point.

The lessons are designed to make learning active, to avoid the electronic page turning that has blighted computer-aided instruction (CAI). According to one student, "The lessons are never dull and are not predictable. Just when you think you've got the professor figured out, something changes. That keeps it interesting."

A particular lesson may contain several sections that you complete locally, working through a problem and finding the answer in the next section. Some sections are to be completed and sent to the instructor. You leave the assignment in the instructor's electronic mailbox. The instructor reads the material and responds within a day or so.

At this point the advantage to the TeleLearning system becomes apparent. The instructor can respond quickly and can customize that response based on knowledge of your ability, interests, and goals. The instructor spends 15 to 30 minutes on each student's lesson, using prepared responses where appropriate but adapting them to each student's needs. It is this human contact, the student's feeling that someone has a personal interest in his or her progress, that distinguishes Electronic University Network courses from correspondence courses or computer-aided instruction.

You can "meet" with the instructor during electronic "office hours" and exchange messages in real time. TeleLearning is presently working to set up bulletin boards where students can exchange messages with other class members and where class "discussion groups" can meet. The goal is to simulate the feeling of community and the interaction that develops naturally when students meet on campus. This can be an important part of the learning process. Perhaps a computer conference is the next best thing to being there.

TESTS

If you are enrolled in a degree program, the college involved is responsible for administering the final exam. For students taking individual credit courses, the CLEP (College Level Examination Program) test often serves as the exam. Tests are proctored, administered at a college or library close to the student.

THE LIBRARY

The Electronic University has, of course, an electronic library. Students have access to extensive on-line database facilities, including abstract ser-

(continued)



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Participating colleges handle course design, consulting with TeleLearning to translate courses to the new medium.

vices, an encyclopedia, and databases for business, education, science, medicine, social science, and humanities. News services, stock market reports, and the *Official Airline Guide* are also available. Students who use the library pay a communication fee ranging from about $10 to $20 an hour (nonbusiness hours).

COURSE DESIGN

In general, the participating colleges handle course design, consulting with TeleLearning staff and using tools provided by TeleLearning to translate their courses to the new medium. The college can choose its top professor in a field to design a course, then recruit graduate students and associate professors to serve as instructors. Instructors are interviewed and monitored by TeleLearning staff and must have graduate degrees and classroom teaching experience.

Dr. Philip Zimbardo is one of the "master teachers" designing a course for the Electronic University. His Psychology 001, the best-attended class offered at Stanford, draws hundreds of students to the lecture hall. Zimbardo sees the TeleLearning course reaching a new audience, a more diverse group of people than he would find within the confines of a traditional university setting, including many of his favorite sort of student: adults who are not in class for a grade, who simply want to learn what he has to teach and who get excited about the ideas he presents.

Zimbardo believes that students in large lecture sections "develop passive learning habits." He is designing his lessons to stress the conceptual meaning of the material, not to encourage rote memorization. For example, in a section on the biology of behavior and the physiological foundations of psychology, students will not be asked simply to list the parts of the human nervous system. Rather, the problem might be: "You have just been hired as a consultant to a high-tech firm that is designing a perfectly programmed humanoid. On the basis of what you now know, you are to design its nervous system. What aspects of the human nervous system would you include, what would you improve, and what kinds of modifications would you make?"

Early, noncredit TeleLearning courses were based on standard CAI and drill-and-practice models. Dr. James Milojkovic, vice president of Educational Research and Development, explains that this sort of electronic page turning is not appropriate for college-level courses, which should put an emphasis on critical thinking and higher-order cognitive processes. "We went back to square one, thinking from an educational rather than a technical point of view," Milojkovic says. "We asked, 'What does a master teacher do?' We looked at the best teachers and the best textbooks to extract the educational principles involved, then we built the technology around that."

Since the people best qualified to develop courses often have no expertise with computers, TeleLearning provides developers with "knowledge templates," predesigned generic structures that they can adapt to each course. Dozens of knowledge templates are available to course developers, and using them can cut the time it takes to create a set of lessons.

Some examples of template structures are the tree-diagram template, which can illustrate any sort of hierarchical structure; a matrix template with which the student can organize material, compare items using appropriate criteria, or visualize relationships among a set of elements; the timeline template, to illustrate any sequence of events; and the T-bar template, for making comparisons.

The templates themselves use rudimentary graphics that the developer can change and adapt as needed. Properly used, they can become sophisticated heuristic tools if the instructor fleshes out the template skeleton with thought-provoking problems. For example, the basic T-bar might be used in an economics course to compare and contrast capitalism and communism in light of issues brought up in the lesson.

In TeleLearning courses, the computer is used only when it is most effective, for interactive study and telecommunication. Milojkovic says, "We don't make the fatal mistake of trying to put everything onto the computer. "A textbook is a perfectly good, portable, random-access information display device, and there's no advantage to dumping the entire textbook and study guide on the computer."

ELECTRONIC UNIVERSITY'S FUTURE

One of TeleLearning's goals right now is to make the student's experience in the Electronic University as rich as possible in terms of human interaction. A real sense of community can develop around people who know each other only electronically. TeleLearning hopes to give as much of an on-campus feeling as possible to the Electronic University.

Other plans include an emphasis on work-related courses in the office. Some companies are already offering tuition and fee reimbursements to employees who take Electronic University courses, and some even provide a workstation in the office.

The Electronic University offers new options to the student who prefers to study at home in a nonthreatening but highly personalized medium. "Many people talk about lifelong learning," says Milojkovic. "We're making it real." ■

Editor's note: To reach TeleLearning, write to 505 *Beach St., San Francisco,* CA 94133, *or call* (800) 22LEARN; *in California, call* (800) 44LEARN *or* (415) 928-2800.

THE TECHNOLOGY OF THE KURZWEIL VOICE WRITER

BY RAYMOND KURZWEIL

The present office system provides a clue to future applications for the deaf

Editor's note: This article is not a review of the KVW; it is a look at a technology that may be available on personal computers in the future.

THE KURZWEIL VOICE WRITER (KVW) is a voice-activated word processor with a relatively unrestricted user-specific vocabulary. The system starts with a vocabulary of at least 5000 frequently used words in the English language. It subsequently adds the words you use that are not part of its initial vocabulary and eventually deletes those words that you never use. Total vocabulary, depending on the KVM model, will be in the 7500- to 20,000-word range.

Voice is our most effective and rapid means of communication, and the ability to interact with computerized information services and devices by voice, without the restrictions of artificial vocabularies or syntax, is expected to be of major benefit. The primary application of the KVW is to automate the creation of written text, which is a fundamental activity in the office. Combining large-vocabulary ASR (automatic speech recognition) with natural-language understanding would also enable professionals and executives to make inquiries of database-management systems or management information systems verbally in natural language instead of through a keyboard.

One planned application of this technology is to create a speaker-independent version of the KVW to serve as a display telephone for the deaf. This would enable a deaf person to hold a phone conversation without being restricted to speaking to other deaf people who have compatible TDDs (telecommunications device for the deaf). It is not yet available but the technology that will be used in its creation is described in essence in this article.

The KVW as it currently exists requires only that you can speak and that you can see. Motion and hearing impairments are not obstacles in its operation. The current version of the KVW is for the business community, but it fills a need for many disabled persons as well. The initial KVM model, which can be shared by multiple users (one at a time) is expected to be introduced this year at a price under $20,000. Future models of both single-user and multiuser systems are expected to be in the $4000 to $10,000 range. While this is beyond the price range of most individuals, the technology is the clue to future, more individually affordable solutions.

LARGE-VOCABULARY ASR

There are two difficulties involved in creating large-vocabulary ASR. First, you must create a set of linguistic and speech-recognition algorithms that provide the requisite recognition power and that are capable of resolving the fine distinctions and ambiguities that are inevitable when you deal with a large natural vocabulary. The incidence of "perplex clusters" (words that differ by only one phonetic feature) is much higher for

(continued)

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a natural vocabulary than for an artificially created command vocabulary. Indeed, many words do not differ in sound at all (homonyms), but can be differentiated only by context. For example, if you want to recognize "To be or not to be, that is the question," you must deal with the first six words, each of which represents a perplex homonym set: (to, too, two, 2); (be, bee, b); (or, oar); (not, knot); (to, too, two, 2); (be, bee, b). Of the 576 possible phrases, all are acoustically correct, but only one is linguistically correct.

Second, you must provide the necessary computing power. Running the algorithms for the KVW on a sequential computer of Motorola 68000 power requires over an hour per word. One reason that the algorithms require this amount of computation is to provide the very high degree of precision needed to deal with the perplexity of a large natural vocabulary. Significant computation is also required to perform the transformations and property-extraction algorithms required to deal with the numerous sources of speech variance that such a system is subject to. Parallel processing provides the speed improvement of several thousandfold necessary to achieve a real-time response time of 250 milliseconds.

The KVW architecture incorporates multiple microprocessors and uses dedicated implementations of specific algorithms in custom VLSI (very-large-scale integration) and discrete circuits. This significantly increases the effective computation throughput levels. A current industry trend finds parallel arrays of dedicated implementations of algorithms in custom VLSI replacing the conventional architecture of a single programmable processor with its one memory space, software, and appropriate peripherals.

VOCABULARY

One type of information that adapts as you use the KVW is the active vocabulary. The system starts out with a vocabulary of at least 5000 common words in the English language. The first time you use a particular word that is not in this starting vocabulary, the system won't be able to recognize it, and you will have to either type it in or verbally spell it in. This process is required only the first time you use a new word; the system will add the word to the active vocabulary and should subsequently be able to recognize it when you use it again.

Words continue to be added until the vocabulary reaches its maximum size, which will vary depending on the model. (The vocabulary size required will vary from user to user. It is expected that user-specific vocabularies in the 7500- to 20,000-word range will ultimately be provided.) After this, new words continue to be added, but the system must drop words from the original set that you have never used. The final result is a vocabulary that should cover the vast majority of words that you use.

MULTIPLE EXPERTS

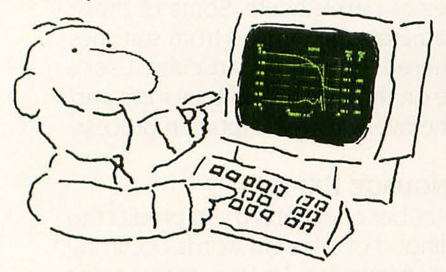
Rather than select a single technique such as Markov modeling, dynamic time warping, robust feature analysis, or high-level feature extraction, the KVW technology incorporates multiple experts, each of which uses a somewhat different approach to the problem of large-vocabulary speech recognition. Different approaches to a complex pattern-recognition task such as ASR have different strengths and weaknesses, and a system that incorporates a variety of techniques is likely to provide better performance than a system that relies on a single method.

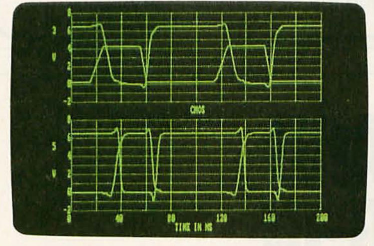
Some of the experts run in real time on conventional 68000 microprocessors, while others require specialized parallel circuitry to provide real-time performance. In this specialized circuitry, 68000 microprocessors provide function control and sequencing, while the circuitry acts like peripherals to them. The resulting architecture consists of multiple 68000s, each with its own RAM (random-access read/write memory) space, plus specialized circuitry incorporating additional RAM spaces.

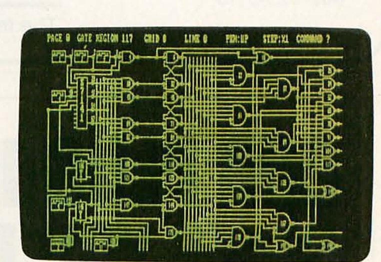
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MICROCAP and MICROLOGIC are available for the Apple II (64k), IBM PC (128k), and HP-150 computers and priced at $475 and $450 respectively. Demo versions are available for $75.

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To take maximum advantage of a multiple-expert strategy, you must combine the results from each expert in a way that recognizes its unique strengths and weaknesses. In general, the system can quickly and accurately resolve each recognition within a small perplex set of words. After this initial cut of the vocabulary to a small set (ranging from one word to a few dozen), the expert-management techniques depend to a great extent on the nature of the resulting perplex set. Some of the expert-management techniques are knowledge-based. For example, the handling of homonym sets is done through a single expert that is capable of differentiating between homonyms based on context. Other techniques involve probability: the methods of combining the probabilities from each expert are controlled by statistics on how the various experts have performed for different types of perplex sets. Some of these parameters are derived from statistics gathered during a particular user's time on the system and thus form part of the overall user-adaptation process.

Language Experts

A number of experts try to predict the likelihood of different words occurring at a particular lexical entry point based entirely on context. These experts use a variety of information-theory as well as sentence-parsing techniques.

The sentence-parsing expert is similar to the type of parser used in some natural-language understanding programs in that a tree-like structure is generated showing the part of speech of each word and its relationship to other words in the sentence. One significant difference is that the KVW parser is able to generate parses on incomplete sentences. At a particular point in a dictated sentence, we have only the "left" part of the sentence (from the beginning up through and not including the current word). Based on each parse of the incomplete sentences as they come in, the parsing expert is able to assign probabilities to different parts of

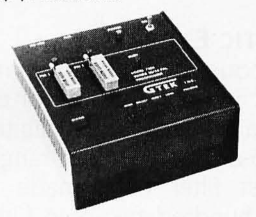
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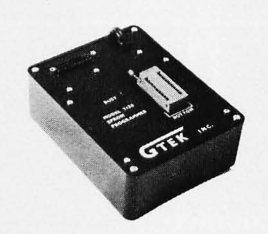
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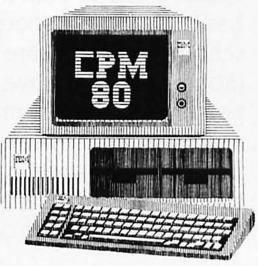
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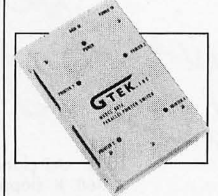
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speech. Rather than the eight or nine basic parts of speech that grade school children are familiar with (noun, verb, adjective, etc.), the KVW parser uses approximately 200 types representing subcategories of the basic parts of speech. This degree of specificity enables the parsing expert to increase the value of its predictions. Using a lexicon of approximately 50,000 words that indicates the likelihood of different parts of speech for each word, the parsing expert is able to assess the likelihood of different words. In particular, the parsing expert is good at eliminating choices that are syntactically unlikely.

There is a fortunate orthogonality between the strengths of the acoustic experts and those of the language experts. For example, most homonyms represent significantly different syntactic types that can be determined from context. "Two," "to," and "too" represent very different grammatical categories with readily identifiable word contexts. Also, short function words, which tend to be more difficult for an acoustic recognizer, are actually easier for the language model to make predictions for.

ACOUSTIC EXPERTS

The acoustic experts share an acoustic front-end processor that includes a high-resolution digitization (over 96-decibel dynamic range) and a robust filter bank made up of several hundred two-pole filter elements with 24-bit accuracy. The resulting spectral data is subsequently processed through a series of normalizations and other transformations to reduce variability and preserve feature invariance. Some of the transformations are based on an auditory model similar in many ways to the human ear's auditory front-end processing.

The acoustic experts utilize a RAM storage of word models, which are updated after each utterance. The acoustic experts are capable of evaluating the likelihood of every word model for a given test token, although the expert manager may request that a particular acoustic expert evaluate only a subset of the models based on the results of earlier experts.

PARALLEL-PROCESSING ARCHITECTURE

One area that uses extensive parallel processing is the front-end filtering. In order to make the fine distinctions necessary to handle the perplexity of a large vocabulary, a great deal of accuracy and resolution is needed in the number of filter channels and the accuracy of both the sample stream and the filters. Filtering is handled by the KSC2408 filter chip (from Kurzweil Semiconductor, a division of Kurzweil Applied Intelligence Inc.) with several

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two-pole filters used for each filter channel. Implementing the 2408's filter algorithm (for a single two-pole filter) on a 68000 requires five seconds to process one second of speech, or five times real time. Each KSC2408 chip includes eight such filters (which operate in real time) and is thus equivalent to forty 68000 microprocessors (for the 2408 filter algorithm). The current model 1 KVW uses 25 KSC2408 chips, which is equivalent to using a thousand 68000 microprocessors for the filtering operation.

The equivalent of several thousand additional 68000 microprocessors (for certain dedicated algorithms, not for general-purpose computation) is provided by other special circuits used in the acoustic-matching process. The language experts and elements of the acoustic-recognition process such as normalization and other transformations are handled by multiple conventional microprocessors.

USING THE KVW

In dictation mode, you simply speak your text in a rapid, discrete manner, with brief pauses between words. The pause required between words is adjustable and should be set just long enough to reduce or eliminate the ambiguity between word pauses and stopgaps within a word. In general, this figure ranges from 100 to 250 milliseconds. The system responds within 500 ms after the end of each word by displaying the recognized word on the screen. A special status line displays any alternate word choices. In trials of the KVW, when the system has chosen the wrong word, the correct word has usually been the first or second alternate given.

The basic mode of operation is to speak into the system and watch the text appear. You don't need to be aware of what is in the active vocabulary. You simply speak and let the vocabulary-adaptation process proceed automatically.

You can also enter commands by voice. To distinguish commands from text, you enter a command mode either by depressing a function key or by speaking an appropriate unique verbal "Enter command mode" instruction (for example, "blix"). Once you enter command mode, you can switch among different types of commands to go, for example, from application-program commands to operating-system commands.

The primary mode of integrating the KVW's capabilities with an application program is through "transparent" integration. In this mode, the KVW simulates the keyboard. Recognized text and commands are converted

(continued)

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into appropriate character strings and transmitted to the operating system as if they came from the keyboard. The character strings come in through a special serial line and an appropriate driver intercepts them and presents them to the operating system as having come from the keyboard.

USER INTERFACE

One user interface that has been proposed for ease of use includes a pointing device (such as a mouse) to control the cursor, which is not easily manipulated by either keystrokes or verbal commands. The mouse would have two buttons, one to toggle between text and command mode and the second to correct errors. Again, you would have the choice of using these two buttons or using verbal commands. You would have relatively little use for the keyboard. Being able to correct most errors, go back and forth between text and commands, and control the location of the cursor would provide most of the control necessary aside from the actual verbal dictation of the text and commands.

To take this concept one step further, you could combine a flat-panel display with a touch-sensitive surface to provide a "pad" that you would hold in your lap or on your desk. As you speak to the pad, words would appear on its surface display. To control the cursor for insertion, deletion, or replacement operations, you would simply point to the screen. The two basic functions of error correction and toggle-to-command mode would be provided by either displayed "buttons," real buttons, or voice command (at your option). For the occasional requirement to type in a new vocabulary word, a QWERTY keyboard could be displayed on the screen.

PHYSICAL CONFIGURATION

The KVW consists of an approximately 100-megabyte Winchester disk, four circuit boards, and a power supply in a standard rack-mountable cabinet. While it would be possible to sit the KVW server next to the workstation it serves, it is generally found in a separate location. Thus, you interact only with your workstation and a microphone. The microphone can be either head-mounted, worn on your lapel, or desk-mounted. It is connected to a small box that digitizes the signal and transmits it on a high-speed serial line.

FUTURE DIRECTIONS

Future applications of the KVW technology include integration with natural-language-understanding systems, domain-specific expert systems, text-to-speech synthesizers, and a variety of application packages to provide executive assistants that are powerful and easy to use. Such systems will have access to the internal databases and MIS (management information system) information of the user's own organization as well as public, semipublic, and restricted-access databases accessed by telecommunications. Professionals, executives, students, and others will be able to converse with such systems to conduct rapid research and inquiry into a variety of questions of interest. Such questions might involve information retrieval ("How did the sales in our Western region for the past quarter compare to those of our three largest competitors?") as well as substantive analysis ("Which financing option for the proposed capital acquisition is best supported by our current balance sheet?"). Questions would be asked by voice in natural language. The questions would be clarified through two-way voice communication (or display), and final answers would be provided by either voice, display, or printout, as appropriate.

The acoustic experts in the KVW are adaptable to continuous speech input. The computation requirements must be increased to handle connected speech, as must the recognition power requirements to handle the additional perplexity of word segmentation, interword coarticulation, and function word reduction. It is expected that economically viable systems that can handle continuous speech will follow discrete-word KVWs within a few years.

The KVW techniques are also adaptable to European languages. The acoustic experts require very little change. The principal changes necessary to the language experts are (1) to provide the appropriate grammar rules to the parsing expert (although the parsing-expert algorithms themselves don't require substantial change) and (2) to train the language experts on appropriate foreign-language text. Foreign-language KVWs will probably follow the English KVW within a few years.

Handling Japanese requires more work than do European languages such as French or German. While Japanese has only about 120 syllables (compared to around 10,000 in English), the syllable set is a perplex one, with many syllable pairs being distinguished only by the duration of the vowel. Also, the differences in Japanese syntax require modifying more than just the parsing expert's grammar rules. Most of the KVW's techniques are, however, appropriate to the language, and a Japanese machine is feasible.

A number of configurations of a speech-to-display sensory aid for the deaf using the KVW technology have been proposed, which the company plans to pursue. Alternatives range from a speaker-independent version of the KVW (with an increased error rate) to a system that displays phonetic transcriptions rather than words. Such a phonetic transcription would contain some insertion, deletion, and substitution errors but could be understood by the user with appropriate training.

CONCLUSION

The introduction of large-vocabulary ASR is expected to provide dramatic productivity gains in creating written text, an optimal mode of communication between persons and intelligent computerized devices and services for information retrieval and analysis, as well as improved understanding and communication for the deaf population. ■

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INCREASING INDEPENDENCE FOR THE AGING

BY K. G. ENGELHARDT AND ROGER EDWARDS

Robotic aids and smart technology can help us age less dependently

FOR THE FIRST time in history, a significant portion of our population is living to be senior citizens, and we have no experience in caring for large numbers of healthy, literate, articulate older persons, many of whom are highly educated. As our society grays, we need more ways to help increase the independence of those with chronic and multiple disabilities. Rapid advances in microprocessor-based technologies are providing us with many new possibilities. Their miniaturization, flexibility, modularity, and ever-decreasing costs now make it possible to realistically address human problems that we could not just 10 years ago.

The need to control our environment and our lives in order to reduce dependence is critical to human development. Loss of personal independence is costly, not only in actual dollars spent on institutional and long-term care, but also in emotional and psychological terms. The need to reduce premature and unnecessary institutionalization of our elderly citizens is critical. We need more devices that will increase the independence and the sphere of control of individuals with disabilities and to augment the care givers' tasks with state-of-the-art tools to help them provide better care.

This article discusses potential applications of microprocessor-based technology for increasing independence in those with declining abilities. From panic buttons to smart houses, from stationary telemanipulators to self-navigating robots, from memory-aid devices to expert systems for daily living, microprocessor-based technology can assist the functionally dependent older person.

APPLICATIONS

An applications team was formed during the winter of 1984 to investigate potential uses for robots and robotic-related technologies. The team identified 54 subgroups of tasks and divided them into 12 major categories: patient transport-lift-transfer, housekeeping, ambulation (walking patients to help prevent bedsores), physical therapy, depuddler (urine cleaner), surveillance (to help with wandering patients), physician assistant, nurse assistant, patient assistant, vital-signs monitor, mental stimulation, and one miscellaneous group. Let's look at some possible robotic applications in a few of these groups.

LIFTING AND TRANSFERRING: The challenge of lifting and transferring individuals with partial or total paralysis, extensive weakness, or increased fragility due to age is significant. One robotic solution could be a track-mounted robot arm that glides along the ceiling until it reaches the room to which it has been summoned. The care giver or the older person could then direct the arm to assist in lifting or transferring the individual from bed to chair or wheelchair to bath, for example. This assistance could also help

(continued)

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An expert system could aid in keeping people independent and in their homes.

reduce back injuries and increase job satisfaction for health-care workers and offer increased independence for the older person.

AMBULATION: This same ceiling-mounted robotic arm could offer an "elbow" to people who need exercise but are a bit shaky, or it could help by pushing a wheelchair along the arm's track corridor. Another solution could be comfortable parachute-like harnesses to safely support weakened individuals in standing positions. These "people walkers" would be programmed to move at varying speeds (under computer control) depending on the individual's prescribed exercise needs. Currently, patients are rarely walked individually on a daily basis because there is not enough free staff time to assist them. Regularly prescribed exercises might affect an older person's quality of life, health, and sleeping patterns.

PATIENT ASSISTANT: Robotic aids can also perform manipulation tasks in an older person's physical environment. Our research has shown that older people are capable of using a robotic aid, and it has identified a range of health and independence-related applications from stationary, sensoryless, bedside-mounted manipulators to problem-solving, self-navigating vehicles with robotic arms that work in coordination. A low-cost manipulator could be mounted on a bedside table, hospital bed, or wall track and perform pick-and-place tasks for a bedbound person. A stationary system with some sensory capabilities, such as force and tactile sensors, could help with some personal grooming and feeding tasks. A mobile, guided vehicle could deliver food trays or perform simple fetch-and-carry tasks. A self-navigating robot wheelchair could transport the individual and have a robotic arm attached to perform manipulation tasks.

DAILY-LIVING EXPERT SYSTEMS

Expert systems that offer cognitive assistance are another possibility. Such a system could help someone with physical or cognitive limitations to make the decisions required in everyday living. An expert system could aid in keeping people independent and in their own homes for a longer time. It could help remind older individuals to perform certain tasks. It could also alert a care giver elsewhere should a change of status signal an emergency situation.

Development of a memory aid or "mind jogger" for specific activities is the first step in creating an expert system for daily living. Such aids are needed for a wide spectrum of people with short-term memory deficiencies. Work on this problem is underway at the University of Michigan (see reference 1). Development of an effective memory aid for those with declining cognitive abilities depends on the system's ability to communicate reminders to its user and on the user's ability to comprehend those messages. Both the quality and content of the information conveyed are important considerations.

What is the best way for a reminding aid to present information so it is most likely to be understood? We know virtually nothing about how much and what kinds of information are needed for various use groups. There is a range of choices that vary depending on the intended user. Whether we use visual or auditory reminders or both depends on the user's "cognitive perceptual and motor demands." Voorhees (see reference 2) has demonstrated the importance of careful integration of multimodal information systems in designing airline cockpits. This analogy is not as farfetched as it may seem, since automated feedback in both instances serves a reminding function. In both cases, we must consider specific characteristics associated with visual and voice output. Our goal, as in Voorhees's cockpit design, is to deliver the "maximum amount of information transfer under conditions of minimum cognitive effort" (see reference 2, page 54). Determining the requirements for devices that improve independence requires examining the functional capabilities of older users. Their cognitive statuses, hearing losses, and visual abilities are three main factors in designing input control schemes and effective verbal or visual feedback.

Lawton's concept of "centers of control" that older people create in their environments (see reference 3) can be a starting point for considering technology's capability for increasing independence. He observes that older people with decreased mobility generally have a favorite easy chair surrounded by those objects that they consider essential, including tables, television, medicines, water and pitcher, pictures, and other personal memorabilia. They usually face an entrance so they know who is entering and leaving. Since elderly individuals often spend increasing amounts of time in their own homes, control over their home environments becomes increasingly important to their sense of independence.

In an airplane, the cockpit is the organized center for controlling an aircraft. Its design allows the pilot to maximize the interactive workspace. Work with disabled persons, whose wheelchairs serve as their primary interactive lifespace, has brought a new meaning to this concept of "centers of control."

VOICE I/O

For older people, voice technology offers a more natural approach to controlling objects and devices within their personal space. They need a natural-language interface that enables them to communicate with the system in everyday English as opposed to computerese.

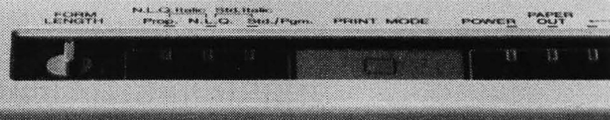
Environmental and remote control of televisions, appliances, stereos, doors, windows, and locks under voice control already exist. Voice operation of entertainment items is

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important also. Security can be enhanced by voice-activated door locks and by using smoke detectors that have feedback designed for "aged ears."

Voice technology might play an important role in functions such as reminding older people to take their medicines. A buzzer or bell gives only one level of communication: sound without content. Voice messages act as a more effective memory jogger by reminding people *what* they need to do.

We can apply principles already operating in natural-language database interfaces to this area. Several age-related considerations could be important in voice input and output and in a natural query language for older users. The jargon or slang of relevant decades could be stored and used to optimize a specific person's ability to communicate by using familiar terms. For example, if you want to ask whether an older person wants to listen to the stereo, you might use words such as "record player" or "phonograph" to improve that person's understanding of the question.

Voice output could also be used interactively with human input to help maximize functional well-being. For instance, a smart system might ask its user, "Can you hear this?" and, based on the response (or nonresponse), adjust volume levels of various output devices. The system could also decrease or increase its speech output *rate* in order to increase intelligibility. In this way, it could temporarily or permanently adapt to changing user or environmental characteristics. Redundancy and repetition may also play important roles in successful use. In one research situation where we worked with older persons with cognitive deficits, the guide rule was "everything in triplicate"—we repeated all instructions three times.

CREATING A SAFER SMART ENVIRONMENT

Another potential application for the aging or disabled person is the *smart card*—"one or more microelectronic chips mounted in a piece of plastic the size of a credit card" (see reference 4)—which can contain a complete medical history and other relevant information and may provide an easy, secure way of interfacing with intelligent machines. If paramedics had card-reading machines, they could obtain vital health information very quickly in an emergency situation. Devices that can read such cards also have sufficient information about an individual to adapt its feedback, pace, and overall interaction to that person's

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People need support without isolation as well as the tools to help protect dignity and privacy.

capabilities. For example, an automatic-teller machine could adjust its speech rate or volume when it detects a particular code on a smart card.

Smart-card technology could also be used to pay for home-delivered groceries ordered through a computerized television catalog. A nutritionist, as part of a home-care team, could maintain a minimum recurring order that the older person could add to. The smart card could pay for and inventory the groceries when they were delivered. In this way, a forgetful older person could obtain and pay for groceries and not have to worry about cash transactions or remembering to buy necessary foods and supplies. Such applications could help delay removing older people from their own homes, from independent living.

Emergency-alert systems provide an individual with immediate access to a health-care affiliate and enable a distressed individual to contact or signal neighbors, family, or professional help. In one European country, the personnel at the midway answering point have met the older users so that the person who responds to the call for help is not an unknown. This blending of a personalized approach with telecommunications technology offers security without isolation for many older people.

Electronic instrumentation enables us to monitor babies during birth, unstable heart patients, and other severely traumatized individuals in order to determine the well-being of a person "at risk." The capabilities of this technology have also been extended to include remote monitoring of well individuals in potentially hazardous situations, for example, astronauts. By combining remote vital-signs monitoring with panic buttons, we can achieve an interactive biotelemetry that provides a chronically but not critically ill person with the physical and psychological security to remain in a home setting. Individuals who are unable to call for help are assured that "someone" will know when they are not functioning properly and will initiate assistance. We need to provide support without isolation as well as the tools to help protect dignity and privacy.

Ultimately, a total living environment that is smart enough to help maximize functional security and capability for a disabled, elderly person may be the best way to care for our growing over-85 population. The first steps to creating a smart, forgiving environment could incorporate current distributed-intelligence capabilities such as appliances (e.g., irons) that turn themselves off when they are not in use, stoves that buzz or speak to you (like the seat-belt reminder to buckle up), and programmed thermostats that help conserve energy.

Brody claims that the first integrated smart house will be built in 1986-87 (see reference 5) and will include appliances that can communicate with each other and with the occupants, environmental and appliance operation from a single TV-like remote-control device or through voice commands, energy-consumption management, and security through various sensing devices. Subsequent efforts could incorporate technological capabilities already utilized in the space program to monitor the health and well-being of a homebound older person.

Conclusion

While we as a nation have conquered many of the challenges of land, air, undersea, and space travel, we have not conquered the frontiers of our own aging bodies and minds. One of the first steps we need to take is functional rehabilitation. If we can provide the assistance that will enable people of all ages and abilities to function at their highest level of performance, we will be taking giant steps forward. Using technology to serve human needs is not a novel idea. However, using evolving electronic innovations in this service role is still an exciting new field to be explored as we begin to understand our older citizens and their roles.

A new era of technology demands a new era of attitudes. The use of technology to augment human independence and dignity is a critical concern for each of us as we also age. Today's elderly have witnessed more rapid technological change during their lives than has any prior generation. Many of these people rode in horse-drawn buggies as children, drove family automobiles in their middle years, and now fly to visit their grandchildren. It is up to us to consider what technologies we want developed and available to us as our abilities also decline, so that we can live longer, more independent lives. ■

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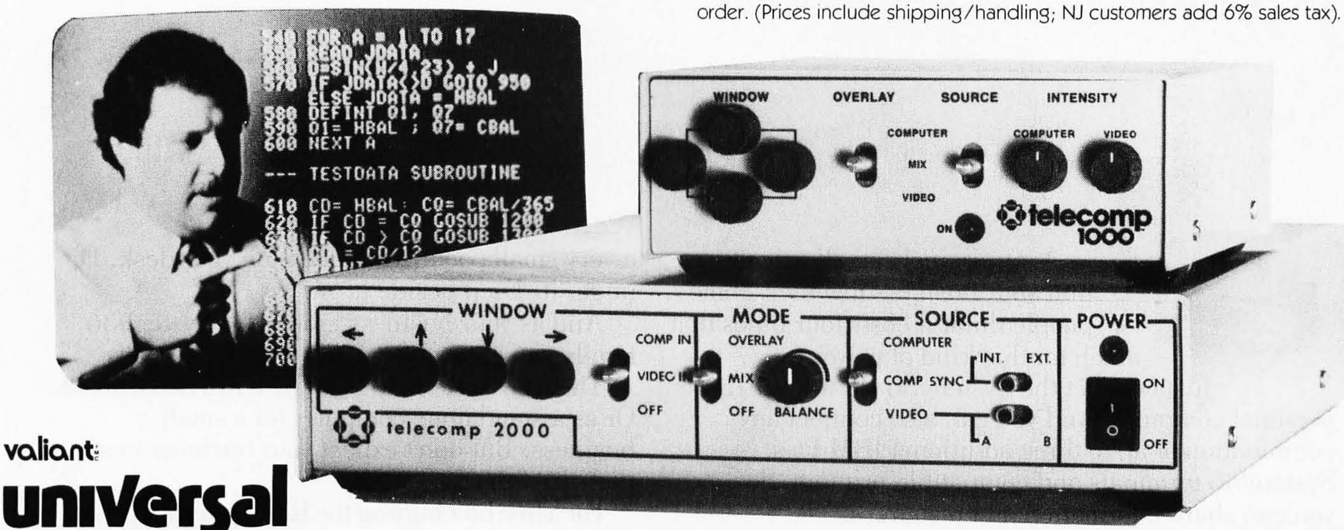
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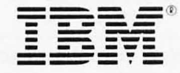
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COMPUTING FOR THE BLIND USER

BY ARIES ARDITI AND ARTHUR E. GILLMAN

Some special human factors must be considered in assembling a workable system

INEXPENSIVE COMPUTERS and nonvisual communications hardware have, in theory, made personal computing as accessible to blind as to sighted persons. But in practice, personal computing has its own special set of problems for the blind user. In this article we'll present some of the human-factors issues specific to nonvisual personal computing. Our concern is to make computers more accessible and efficient for blind and visually impaired persons. We hope our suggestions will be useful to individuals and to designers of hardware and software. Many of the improvements we discuss below can be implemented in several ways, often in more than one component of the system. They are intended to illustrate human-factors issues rather than to critique specific products.

The system we use as a basis for this discussion is a popular one for blind and visually impaired users and is inexpensive enough for home use as well as employment settings. It consists of an Apple IIe microcomputer operating under DOS 3.3, a Votrax Personal Speech System for voice output, and Raised Dot Computing's Braille-Edit program version 2.44a. [*Editor's note: There is a more recent version of Braille-Edit with a number of new features and enhancements. See Henry Brugsch's review, "Braille-Edit," on page* 251. *Also, for an address list for manufacturers of products mentioned in this article, turn to page* 208.] Most blind users have a printer for producing sighted (conventional) hard copy. Another useful peripheral is a braille printer, since braille hard copy is easier to proofread than voice output. While we will not specifically discuss braille hard copy, many of the human-factors issues discussed here are relevant to the design of braille printers.

Braille-Edit is an integrated software package designed to satisfy most blind users' needs to process documents. It is intended for use with a low-cost artificial-voice system such as the Votrax Personal Speech System or Street Electronics' Echo series (including the Echo+ speech synthesizer) and various other peripherals. Braille-Edit is not intended to (and does not) make all programs that run on the Apple accessible to the blind user, nor is it particularly useful in programming the computer. But it has a number of desirable utilities for the blind user, such as a translator of text to and from grade II braille (a commonly used coding system similar to Speedwriting shorthand) that makes impressively few errors and a copy facility for copying files to and from a paperless brailler such as the Versabraille from Telesensory Systems Inc. (TSI).

The hardware and software designed to make a system accessible to the blind user can be viewed as an in-

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Our concern is with the accuracy, speed, and generality of the blind-user interface.

terface between the user and hardware or software that presumes that the user is sighted. Our concern is with the accuracy, speed, and generality of the blind-user interface. Accuracy and speed are areas in which data transmission to and from the computer can be improved by better design of the individual components of the interface or by the coordination or compatibility of the components. Speed and accuracy need to be balanced to produce the greatest levels of efficiency. Generality has to do with the scope of programs not specifically written for blind users that can be run by the blind user as a result of interface design.

ACCURACY

Inaccuracies in data interchange between the blind user and the computer arise from imperfect translations of normal input and output into the special modes of the blind user. The normal text output of the screen must not merely be redirected to a voice device but must also be translated into speech that effectively conveys all of the information on the screen. Similarly, if you type in braille, the braille text input must be accurately translated to standard computer text prior to processing.

One of the main functions of any voice-based software interface is to send the text that would normally go to the screen to the voice-output device. The fact that text data is not essentially visual is what makes the accessibility of computers to blind people possible in the first place. The voice peripheral receives streams of characters and pronounces either full words or individual characters. Full-word pronunciation breaks up each word into likely phoneme or allophone strings based on its spelling. Even though there may be errors in pronunciation resulting from exceptions to these pronunciation rules, this scheme has the advantage of an unlimited vocabulary of pronounceable words. An excellent and readable discussion of issues relating to text-to-speech conversion can be found in reference 1.

Full-word pronunciation is desirable when the computer is prompting the blind user or conveying the results of its operations. For example, it is quicker and more natural for the system to pronounce "Enter selection" than to spell it out. Full-word pronunciation is also useful in editing documents, primarily as a means of finding your place in a document. But you cannot rely on artificial full-word text for other aspects of editing because text-to-speech conversion pronounces neither nonprinting characters such as space or tab characters nor punctuation symbols that are embedded in a text file. Typographical errors are also difficult to detect since they may result in only subtle if detectable pronunciation errors. For example, a voice device would pronounce "really" the same way it would pronounce "reelly" because it would analyze the two character strings into the same component phonemes (or allophones).

Spelled-pronunciation mode is the only viable way to know precisely which text characters have been typed and is therefore preferred for most editing and all proofreading. But even with spelled-pronunciation mode it may be difficult to distinguish between similar sounding letters such as "m" and "n" or "t" and "p."

The particular voice device you choose determines both the intelligibility of the artificial speech and usually the quality of the text-to-speech (full-word pronunciation) conversion. The "voice synthesizer" chip within the device is responsible for generating the sounds corresponding to each phoneme or allophone element, and the discriminability of such sounds is largely determined by this chip. A microprocessor and memory, also parts of the voice device, typically perform the text-to-speech conversion. The time and memory taken by the algorithm that implements the conversion are important factors influencing the accuracy of the conversion. Although most speech devices allow you to control a number of speech parameters, such as speech rate, inflection, and pitch, through special commands or controls, none of the less-expensive speech devices has as yet incorporated these parameters into their text-to-speech algorithm. This would excessively reduce the speed and/or increase the complexity of the algorithm. The result is a usually intelligible but monotonous parade of pronounced phoneme strings separated by short pauses for word separation. The near future will undoubtedly bring us more natural sounding artificial speech at low cost.

Thus far, we have discussed problems translating text to voice. Translating braille to text poses additional accuracy problems. One way for a blind user to enter text into the computer is with a braille keypad or keyboard. The braille keypad can be simulated with an ordinary keyboard by using the space bar and the six keys on the lower tier of the keyboard. These six keys correspond to the dots of a braille character cell. With Braille-Edit you can choose to have whatever is typed show up on the screen as ordinary print-style text (through braille-to-ASCII conversion) or as visual braille, which is of some use to the sighted transcriber.

However, the lack of a one-to-one correspondence between ASCII codes and braille symbols causes significant problems. If the software doesn't take this into account, you will get garbage on the screen and gibberish through the voice device. For example, the "dot 6" character in braille signifies that the next character should be interpreted as uppercase. To have the text spoken out properly, the software that takes input

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Rates of information exchange between the user and the machine will be inherently worse for a blind user.

from braille-keypad mode and sends it to the screen or speech synthesizer must delete dot 6 characters and capitalize the first character of the subsequent word. This is fine for final copies of documents, but since this translation takes time, it is not really practical for writing and editing. To make the braille-keypad mode usable for editing documents, the voice-output device must be made to say "dot 6" or "capital" at the moment a dot 6 is encountered. This can either be done within programs like Braille-Edit, or it can be incorporated into intelligent voice-output-device firmware, whereby they can be made to run in braille mode, filtering out all special braille characters and making appropriate translations when the text is received.

A specific difficulty for systems using braille input resulting from the lack of one-to-one character correspondence is that if you are using the braille-keypad mode, two different systems for coding numbers may have to be remembered. Standard braille uses the convention of coding numbers as strings of characters whose ordinal position in the alphabet (for "a" through "i") is equal to the value of each digit in the number; each such string is preceded by a braille "#" character. For example, the two-character string "34" corresponds to the braille symbols for "#cd," a three-character string, and the print and braille translation facilities assume that numbers have been typed in the latter format.

But user commands that include numerical arguments (e.g., the command for "advance the cursor 34 characters") are best entered as Nemeth code, a system of braille used for mathematics, in which braille numbers are represented by a string of characters just as in ordinary braille. However, in Nemeth code, the number is not preceded by "#"; instead, each character in the number is shifted down one row in the braille cell matrix to distinguish the character as a digit. Because Nemeth code omits the "#," a Nemeth number requires the same number of characters to represent as a print-style digit string and therefore is much more easily translated into a string of ASCII digits.

These translation problems should not necessarily be solved with software. It would not be difficult, for example, to design a braille keyboard that emulates and could replace a standard keyboard. Likewise, a voice device could easily have a braille-to-voice conversion mode built into its firmware.

Another solution to braille-to-text translation problems is for the blind user to learn to type with a standard computer keyboard as Braille-Edit users do. This circumvents the lack of one-to-one correspondence between braille and ASCII codes entirely. By using spelled-pronunciation mode, you get immediate feedback as to which keys you have pressed. (Incidentally, small raised dots on the D and K keys of the Apple keyboard aid in finding the home keys.)

SPEED

Rates of information exchange between the user and the machine will be inherently worse for a blind user than a sighted user because vision conveys text information more quickly than other sense modalities. The sighted user viewing a display screen can receive a screenful of information all at once, whereas the blind user working with artificial-voice output or a braille computer terminal receives information from the computer in serial fashion only and much more slowly than the sighted user. Because of this, increasing speed is especially important for the blind user.

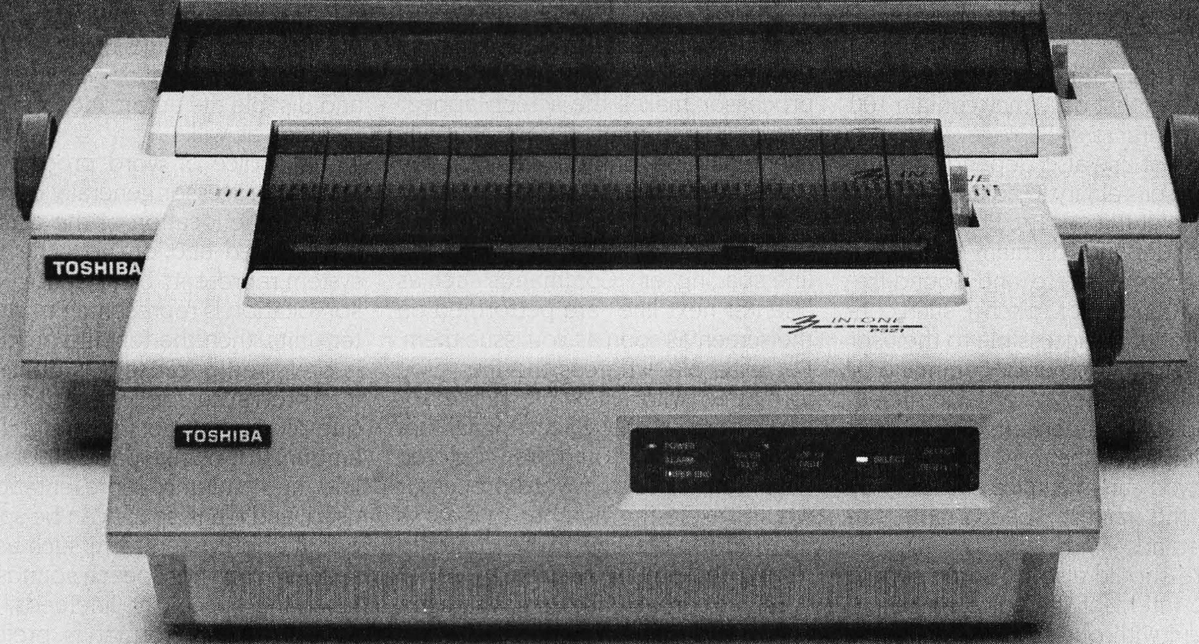
A general design issue that greatly affects the speed of the blind-user interface is the choice of driving the program by menus or by command language. A menu lists on the screen all the options currently available and prompts you to select one. This has the advantage that commands need not be memorized, and thus the user does not need experience to run the program. In contrast, a command language generally provides only a prompting character such as "*" to signal that the program is ready to receive a command. It takes time to learn a command language, but once you learn it, you can specify desired actions more tersely and more quickly than with a menu.

For the blind user, the menu format is especially slow because the menu must be listened to rather than seen. Also, since it is easy to forget options listed early in the menu, lengthy menus must often be repeated. For these reasons, we think command-language format is better for the blind user. Command languages often provide help-command supplements as teaching and mnemonic aids. The command language with help facilities combines the advantages of a menu with those of the command language because you can use a help menu while learning the program and avoid it when it would otherwise be unnecessary clutter.

Another bottleneck that reduces the speed of the blind-user interface is the difficulty in translating screen format to voice format. Redirection of the screen contents to the artificial-voice device makes the primary output of the computer intelligible, but a good deal more effort must go into making the output easily accessible to the blind user. Since so much software is screen-oriented, it is desirable to buffer the output to a "virtual screen." This virtual screen is an area of memory that contains one or more screens full of text and a virtual "voice" cursor. The virtual cursor may be moved about the virtual screen without affecting the contents of the ordinary terminal cursor. With key-

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stroke commands such as "Speak phrase at cursor," the blind person can quickly read text anywhere on the screen. This feature has been incorporated in several "talking terminals," in TSI's VERT, and in other recent software packages for the IBM PC.

It is important for the user to know the locations of both the actual and the virtual cursors, and there should be a command serving this function. Locations should be spoken out as line and column number rather than serial character position because it is easier to imagine location in two dimensions than in one. For example, it is of limited use to know that you are 323 characters into a page, especially when that page may contain 100 space characters.

Speed of use also depends greatly on the user's ability to adjust voice parameters of the system. Because intelligibility depends on many factors, including speech rate and sound-frequency content (or "pitch"), such controls should be accessible to the user in some way, whether by command or by knobs on the voice device itself. Your ability to understand the artificial voice improves the more you listen to it, and you can maximize efficiency by using the fastest speech you can understand.

There should also be some simple way to interrupt the voice device. A problem with our example system is that during output of long menus, the only way to terminate voice output is to turn off the power switch on the voice unit. Otherwise, you must listen to boring, lengthy menus you have memorized so thoroughly that it is irritating to have to wait for them to finish. Turning off the power on the voice device to clear its buffer and force it to silence also resets the unit. Then commands to set parameters such as speech rate must be sent all over again. A special key or button on the voice device could be dedicated to the "Abort voice output" function.

The choice of word processors versus text-file processors also affects user speed. These are two fundamentally different approaches in programs designed to aid document writing. With what we call the "text-file processor" approach, you create a text file with commands embedded within the text to be executed later by the text-file-processor program. These commands do nothing to the text on the screen during an editing session but give the text a more pleasing spatial layout later, when the chapter is printed through the text-file processor. The embedded commands are, of course, filtered out and do not appear in the output.

A more popular approach with personal microcomputers is that of the word processor, in which editing and formatting the page are combined in the same process. Writing with a word processor makes the screen appear similar to the printed page that will eventually be printed out. As you type, the words are automatically arranged on the "page" to fit within the margins with the currently selected line spacing, etc. Commands such as "Center next line" are performed on the screen as soon as you issue them. For example, whereas the file to be formatted with a text-file processor might contain only $$c to signal that the next line should be centered when formatted, the word processor would insert the number of spaces needed for the line to be centered during the editing session.

Each approach has its advantages. Files to be text-formatted are much shorter because blank spaces and lines are added only when the file is processed. Also, you can make sweeping changes to the entire file with single commands such as "Set double spacing." For the blind user working with voice output, blank space and lines are abbreviated as commands such as $a20 rather than being counted one by one as the voice device repeats "space, space, space. . . ." A disadvantage of text-file processors is that it is more difficult to imagine how the page will appear when printed out. Although this might not seem to be a drawback for blind users, in fact most blind people make use of spatial imagery in similar ways as sighted people (reference 2) and *do* imagine the spatial structure of the printed page. Another disadvantage is that the command strings may be somewhat distracting when spoken out by the voice device in full-word pronunciation mode.

Advantages to the word processor are that the text need not be cluttered with the embedded commands, and you see the page in a form that is more similar to its printed appearance. A disadvantage is that since the text is being rearranged continuously during editing, words move about more. It may be difficult for the blind user to find words, since they rely more on the constancy of word positions in each line. Most word processors, however, allow you to enable and disable the automatic formatting facilities at will.

The choice of word processor or text-file processor generally depends on how the location of the cursor is represented and on how the voice system represents blank space. If cursor location is represented in character units, then the text-file processor is preferred because it is difficult to interpret a cursor location number due to the possibility of significant amounts of blank space. However, if line and column representation is used, and blank space can be spoken out in abbreviated form such as "20 spaces" or as nonspeech sounds representing spaces or linefeeds, then word-processor format is preferred because it is easier to imagine the final output.

GENERALITY

Finally, generality must be considered in designing a system for the blind user. Although a system designed from the bottom up to serve only blind users would have obvious advantages for the blind person, a more realistic goal, and one that fosters better communication with sighted users and produces more employment opportunities, is to design a system that gives the blind user access to all general-audience software that is not intrinsically visual.

A flexible and general system should allow the user to customize

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the workings of the blind-user interface. You should be able to set all parameters of that interface while an applications program is running. Generally, this involves having either a separate keypad or switches on the voice device, or a special switch or command that redirects normal keyboard input to the voice device. This approach would avoid the possible conflicts between keys (e.g., function keys) that are used both to operate the applications program and to control the voice device.

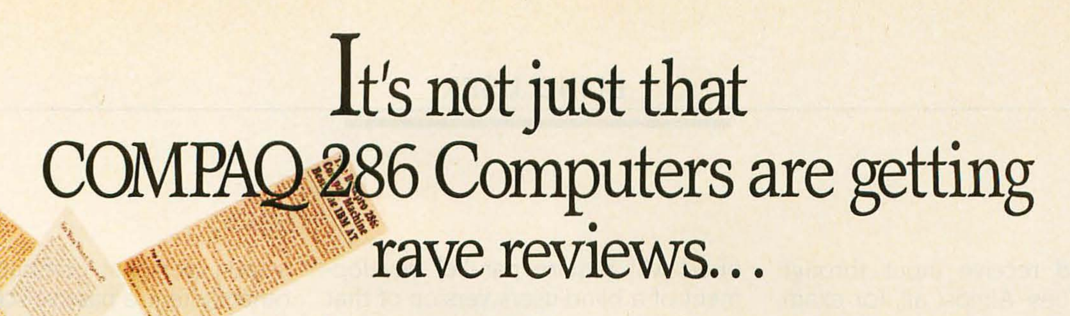
Some voice devices now allow considerable flexibility in speech style, including options such as whether numbers ought to be pronounced by individual digits or as full words, how to handle abbreviations and acronyms, whether or not to signal punctuation symbols, etc. Some allow you to redefine pronunciations of words and thus correct deficiencies of the text-to-speech algorithm. Such options can be useful, but they *must* be easily accessible through hard controls or software. Our Votrax speech synthesizer, for example, has codes to set the speech rate and to abort speech, but Braille-Edit has no facility to send such commands. If the Votrax had separate knobs or buttons to control them, the system would be completely software-independent in regard to these functions.

Another important feature of the virtual screen with the virtual cursor described above is that it allows blind users to read portions of the screen that they would not be able to read with an ordinary cursor. An ordinary cursor is generally prohibited from moving into certain areas of the screen (protected fields, e.g., an area that displays current margin settings, tabs, etc.) where information is displayed constantly rather than being pushed off the screen (from scrolling) after the screen is full. With the ordinary cursor, the blind user has constant access only to those portions of the screen that have been explicitly directed by the program to voice output. But a virtual cursor can move within the protected fields, and you can read what would otherwise be hidden without affecting the actual cursor that must obey the boundaries set by the applications program.

Perhaps the major disadvantage of our example system is that it is not possible for us to run any applications programs that are not specifically designed for the blind user. Braille-Edit is a useful program that performs all the functions featured on its menus and probably makes the Apple II computers more accessible to blind people than any other system, but greater flexibility can be achieved by systems that modify or extend the operating-system facilities.

Most applications programs send

(continued)



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output and receive input through these facilities. Almost all, for example, request the operating system to type characters on the screen rather than writing a new section of program to perform this task. They do this both because it is easier and because it maintains the generality of the program; i.e., the program will run on all machines that use the same operating system. If the operating system is modified so that all screen output also automatically goes to a voice synthesizer, then virtually any program that is run will send whatever ordinarily goes to the screen to the voice output as well. Operating-system modifications would have the generality that allows programs not written for blind users to be accessible to them nevertheless. In this way, blind and sighted users can work together, using the same software. Braille-Edit is not this kind of modification—it is simply a good applications program written for the blind user. The alternative to operating-system modification is that each commercial program that is developed will require parallel development of a blind-users version of that program.

In recent months several new systems have been offered commercially that do work by these principles. One is TSI's Professional VERT, a voice-output hardware and software configuration for the IBM PC that we have not evaluated. Another is an operating-system modification and addition called The Enhanced PC Talking Program (from Computer Conversations). This program also runs on the IBM PC and will work with most inexpensive voice-output peripherals, although the Votrax Type-'N-Talk is recommended. Another similar, more recent package for the IBM PC from Computer Aids Corporation is called Screen Talk. Both VERT (with an additional plug-in board) and The Enhanced PC Talking Program can emulate several popular computer terminals, making them especially attractive in employment settings. Finally, Maryland Computer Services' Total Talk PC system is a talking version of the Hewlett-Packard HP 150 Touch-screen personal computer. Yet another system, a passive screen reader card for the IBM PC, currently being developed by Tim Cranmer and others at the National Federation of the Blind, will not modify or add onto the operating system but will receive and interpret all data sent to the video screen buffer, so that even programs that bypass operating-system calls to write to the screen can be run.

The rapid introduction of so many new systems illustrates how rapidly the field of making computers accessible to blind persons is growing and becoming more competitive. Undoubtedly the capabilities of computer hardware and software designed for blind users will continue to grow in parallel with the capabilities of systems designed for sighted users.

For a microcomputer to be as accessible as possible to blind people, designers must interface the system to the blind user at as primitive a level as possible. If the computer's operating system "thinks" it is receiving standard keyboard input but is in fact receiving braille that is translated before it is received by the operating-system software, then any program that uses the keyboard ought to be able to use braille entry as well. Similarly, if the operating system "thinks" it is sending output to a screen but actually sends it to a buffer that holds as much as a screenful or more, the blind user can peruse desired sections of it much the same way as a sighted person, for whom the program was originally designed. We hope that our observations have provided some structure to the various problems in designing a blind-user interface. We feel that solutions to the problems we have described will contribute to the more efficient and broader use of computers by blind people. ■

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REFERENCES

1. Stoffel, David. "Talking Terminals." BYTE, September 1982, page 218.
2. Kennedy, J. M. "Haptic Pictures." *Tactual Perception*, W. Schiff and E. Foulke, eds. New Rochelle, NY: Cambridge University Press, 1982.

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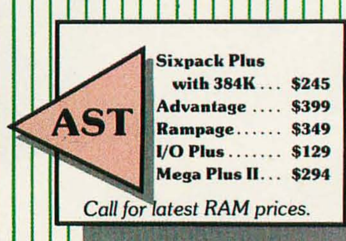
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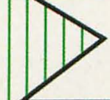
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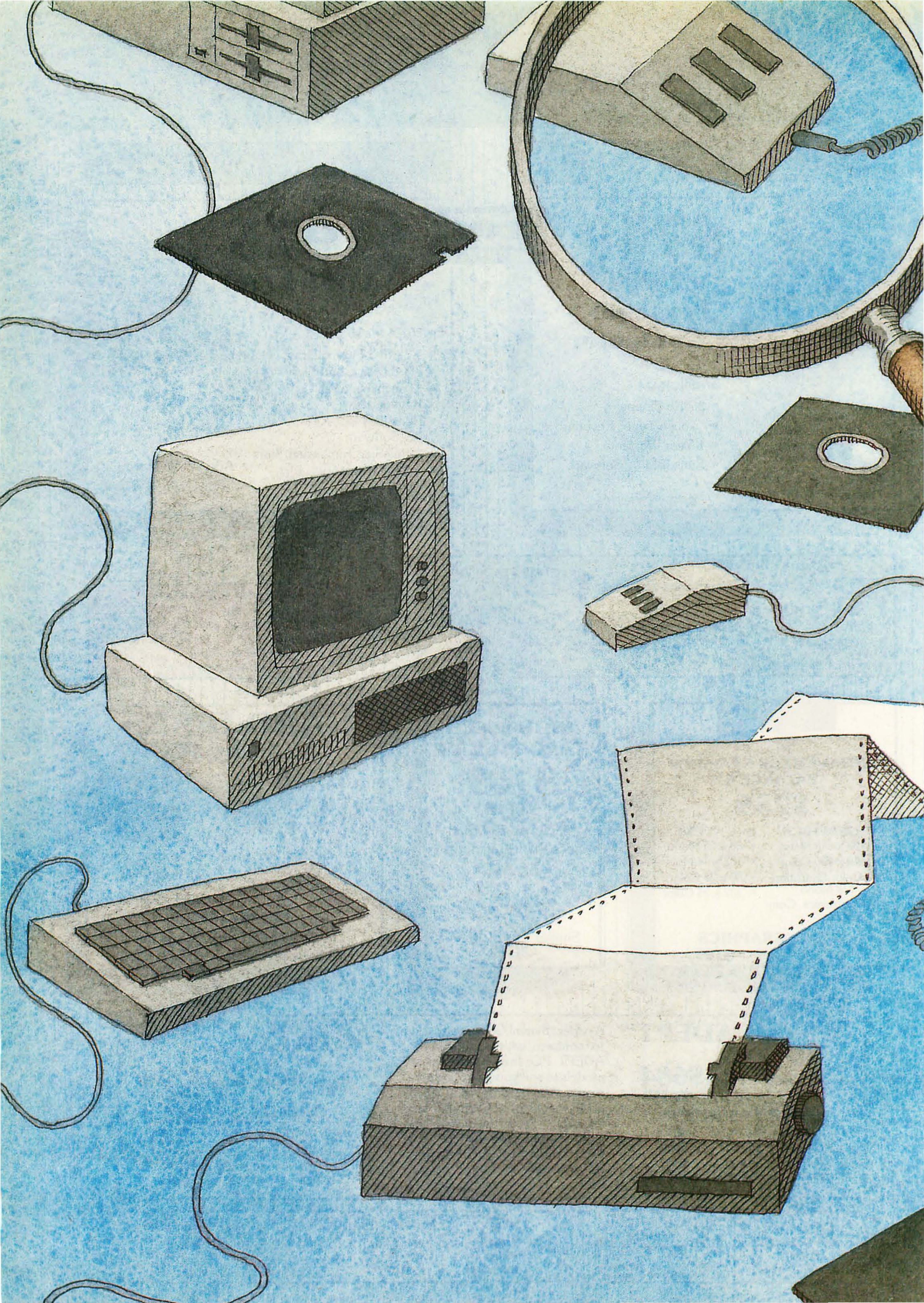
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Reviews

THIS MONTH'S SECTION starts with an in-depth look at one of the proliferating generation of machines based on the 80286 processor, the Kaypro 286i. A fact about the machine, which is either a benefit or a defect depending on how you view the IBM PC AT, is that the two machines are so close as to be nearly indistinguishable. On the other hand, there is a wide gulf between the prices that our reviewer, Harry Krause, found advertised for the IBM PC AT and the Kaypro 286i.

Reviewer Brian R. Anderson looks at a Modula-2 compiler system for Z80 CP/M from Hochstrasser Computing AG. Mr. Anderson begins by noting that the close association between the authors of the compiler and the author of the language led him to expect a high-quality product. He reports that his expectations were fulfilled.

Eric H. Johnson begins his review of Pocket APL by noting that its cost and special hardware requirements have hampered the spread of a generally popular language outside academic or corporate environments. Now comes a new version of the language that runs in as little as 128K bytes of memory and requires no special hardware. On top of that, it's a complete implementation of the language. Drawbacks? Some. Are they serious? Not if you use the language as a learning tool or to write fairly small programs.

Arity/Prolog is an implementation of Prolog for MS-DOS systems and, says reviewer William G. Wong, one that matches implementations found on a number of mainframes. Given the fact that this version of Prolog is not cheap (you can pay from $495 for the base version Prolog interpreter to a whopping $1950 for a native-code compiler with the interpreter), you would expect it to have something going for it. In Mr. Wong's view, it does indeed.

Braille-Edit from Raised Dot Computing is a word processor that utilizes just about every kind of input and output not dependent on sight. For example, you can print to braille or print to paperless braille (storing braille characters on magnetic tape), you can run it on a variety of speech devices, and you can write files in braille using dedicated keys on the computer keyboard. One of the things blind computer users have long complained about is that products for them were simply shoddy, that they didn't represent a large enough "market segment" for vendors to take seriously. Reviewer Henry Brugsch gives careful consideration to the overall quality of this talking word processor and delivers his judgment on how well Braille-Edit conforms to or rebels against that trend.

In our final review, we hear again from Henry Brugsch, this time collaborating with Joseph J. Lazzaro on a discussion of Printit—a card that lets you print anything you can get up on your Apple II's screen. Printit can also send any nongraphic data to a speech-output device. If you want your software package to "talk," and it won't do so in any other way, Printit will let you hear any text you can get on the screen.

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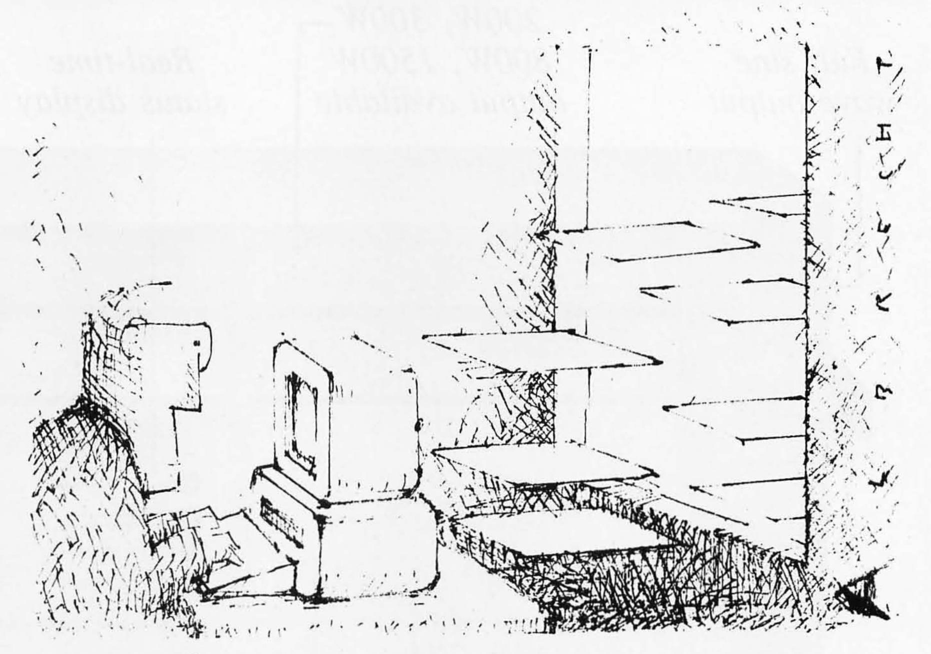
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We've been concerned by what we thought were electrical power problems, so when we saw a power-line monitor designed to work with micros, we felt that this was something we ought to explore. It's called the Powertrac and it comes from Vertex Systems Inc. in Los Angeles. It consists of a power-line interface that plugs into your computer's serial port. From there, a connection leads to an Atari plug-in power supply that you slip into a wall socket. So much for setup. The software is a disk with programs for collecting data on power-line conditions. It'll function as a background data logger if you want to leave it on and running while you go about your normal tasks. When you decide you've sampled an interval long enough, you pull a report. You can also use it as a real-time monitor with a graphics display that simulates a strip recorder. Another graphics display shows up as a crude oscilloscope to help you point out voltage spikes and high-frequency noise. The version we got is for use with the IBM PC, but there's also one that works with the entire Apple II series. The company notes, however, that the background data logger only works on the IBM PC version.

Powertrac generally seems to work pretty well. It's actually kind of fascinating to watch it redraw the graphs every minute or so. Major problems tend to be spectacular enough that we're not really interested in calm, rational responses. But in the normal course of things, you could probably use the Powertrac to make a case for calling in the electrician or asking your next-door neighbor to shut off the arc welder. The Powertrac would probably be a handy thing to have if you moved your computer around a lot and wanted to be sure you weren't dealing with a flaky electrical system before you got too deeply involved in an important application.

Super Utility, from Powersoft Products in Dallas, is a repair kit for damaged data files. You use it, first and foremost, to unerase files that you've accidentally gotten rid of. Beyond that, however, it has functions to edit, verify, or modify sectors, copy sectors to files, do sector diagnostics, map file-allocation tables for individual files or whole drives, edit directories and subdirectories, rename files, set their attributes, and do string searches.

This is the same company that makes the popular disk utility program of almost the same name (Super Utility Plus) for the TRS-80. They put a notice in their sales flyer that Super Utility PC is not SU+ "ported over" from the Tandy line. Fair enough, but if you're already familiar with SU+ you'll be on more familiar ground.

I think one of the nicer aspects of Super Utility is the fact that it's very simple and straightforward. The company seems to have remembered that someone who's just erased a file or a disk is not going to be in the mood for lighthearted banter that gets in the way of quickly and faultlessly restoring all that lost work. The directions in the little documentation pamphlet are clear and to the point.

Once you call the program by typing su, you get a screen with a copyright notice, and it also tells you to hit the escape key if you're having a hard time reading the screen. It does this because it's normally set to work with a color monitor and can be unreadable with some monochrome units at first. Once you tell it, in effect, what kind of monitor you have, you go right to a menu that asks you what you want to do and it lets you do it.

When you want to unerase a file, the program shows you a DOS directory of your disk. Those that have been erased—but not yet overwritten—will flash and are printed on the screen with the first letter of the filename missing. You supply the missing letter and the program gives you a screen full of data, asks you if it looks like the data you're trying to restore, and tells you to press the return key if it is. It samples each cluster of likely data and you restore the file, or program, in increments.

Powersoft says you can use Super Utility with the IBM PC, XT *or AT and* such compatible computers as the Compaq, AT&T 6300, and Tandy 1000, 1200, and 2000. It's being introduced at $89.95 and looks like something that would be a comfort to have around.

Glenn Hartwig
Technical Editor, Reviews

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Kaypro 286i

An AT clone at a good price

BY HARRY KRAUSE

The Kaypro 286i, a well-designed and well-manufactured clone of the IBM PC AT, is widely available from retail dealers at what appear to be bargain-basement prices.

The $4450 list price (about $1000 less than a similarly equipped IBM PC AT) includes 512K bytes of RAM (random-access read/write memory), two 1.2-megabyte floppy-disk drives, a built-in battery-backed clock and calendar, a color-graphics driver board, two built-in parallel ports and a nine-pin serial port, an RGB (red-green-blue) monitor, and a large assortment of software. However, you can obtain the computer far below the list price; local Kaypro dealers in the Washington, DC, metropolitan area advertise the basic system for $3000, or about $2500 less than a similar IBM product. One dealer offered the machine with a 20-megabyte hard disk for $3295.

Like the IBM PC AT, the 286i uses the Intel 80286 microprocessor running at the same 6-MHz clock speed. The main board of the evaluation unit had 512K bytes of 150-nanosecond RAM chips. Two rows of nine 256K-bit chips each (the extra chip is for parity checking) provide 512K bytes. IBM took a different approach on the AT, using piggybacked 64K-bit chips. The Kaypro solution is more elegant.

Two additional rows of empty memory-chip sockets are next to the 256K-bit chips, and you might assume that you can fill the empty sockets with additional 256K-bit chips (for a total of 1024K bytes of RAM on the motherboard). However, the Kaypro documentation indicates that the empty sockets are for 64K-bit RAM chips only, limiting the motherboard to no more than 640K bytes of RAM, the limit of memory directly addressable by current versions of MS-DOS. If Microsoft raises the 640K-byte memory limitation, you might try installing the additional 256K-bit RAM chips. The machine's design and the capabilities of the 80286 CPU (central processing unit) allow up to 15 megabytes of system RAM.

The rest of the Kaypro's guts resemble an IBM PC AT, with generic chips, boards, drives, and sockets. The 286i's motherboard has a socket for Intel's 80287 math coprocessor chip, but the evaluation unit did not have one. The disk-controller card looks just like the one in a PC AT and can handle two hard disks and two floppy disks.

Kaypro shipped its first 286i machines with two floppy drives and later announced the availability of hard disks. The evaluation unit had two 1.2-megabyte floppy drives; you can purchase your unit with a 1.2-megabyte floppy and a 360K-byte floppy or just one floppy drive. The Kaypro dealership I contacted was getting different hard disks for the 286i from three different manufacturers. The dealership installed the drives, a fairly trivial task that takes no more than half an hour and a couple of common hand tools. Compatible 20-megabyte hard disks are available for under $1000.

If you buy your own hard disk, make sure it comes with adequate instructions; you won't find much help in Kaypro's manuals. The bundled software includes voluminous documentation, but the hardware manual is an inadequate 32-page booklet. In fact, it might be a good idea to buy an IBM PC AT technical manual.

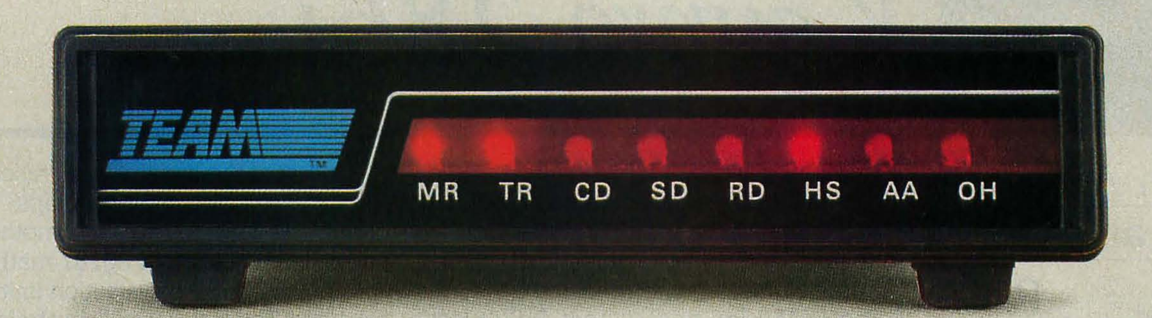
Kaypro did not include an operating system with its early production of the 286i. According to the documentation, the computer requires either PC-DOS 3.*x* or MS-DOS 3.*x*. Therefore, you will need to buy Microsoft's MS-DOS 3.*x* operating system separately, perhaps from an IBM PC dealer if Kaypro has not yet released its version. Kaypro does bundle GW-BASIC, which runs most programs written for BASICA.

Kaypro is also bundling WordStar Professional, MailMerge, PolyWindows, and MITE (for telecommunications), but if you are already using good applications software, you may not want to switch from your programs. I had no trouble running any software written for the PC AT. I could not run soft-

(continued)

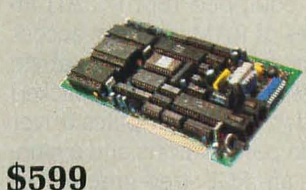
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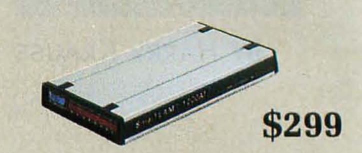


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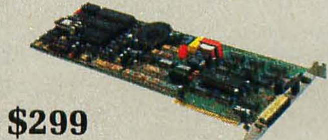


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AT A GLANCE

Name
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Company
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533 Stevens Ave.
Solano Beach, CA 92075
(619) 481-4300

Size
21 by 16½ by 5½ inches
System unit (without hard disk) and keyboard: 40 pounds

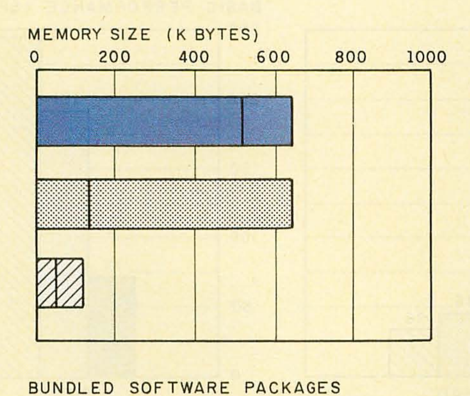
Components
Processor: 6-MHz Intel 80286
Memory: 512K bytes of 150-nanosecond 256K-bit RAM chips standard, expandable to 640K bytes
Display: Kaypro 14-inch RGB monitor, 80 characters by 25 lines
Keyboard: Detached with 84-key QWERTY layout including 10 function keys, numeric keypad, Caps Lock, Num Lock, Scroll Lock, and indicator lights
Expansion: Eight expansion slots
I/O interfaces: Two parallel ports, serial port, RGB monitor port

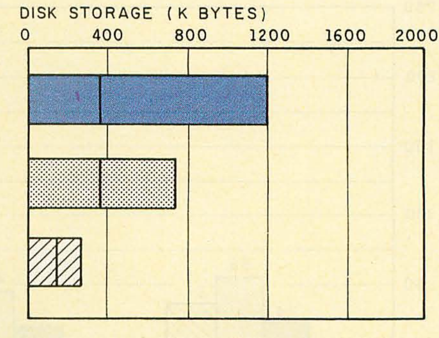
Software
GW-BASIC, WordStar Professional, MailMerge, PolyWindows, and MITE

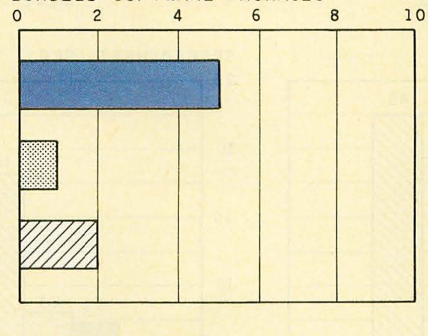
Documentation
32-page user's manual for computer, voluminous manuals for software

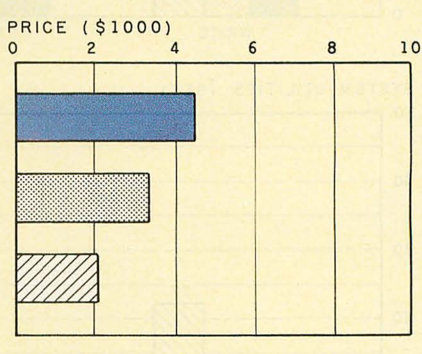
Price
Dual 1.2-megabyte floppy-disk system $4450

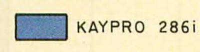


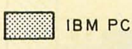










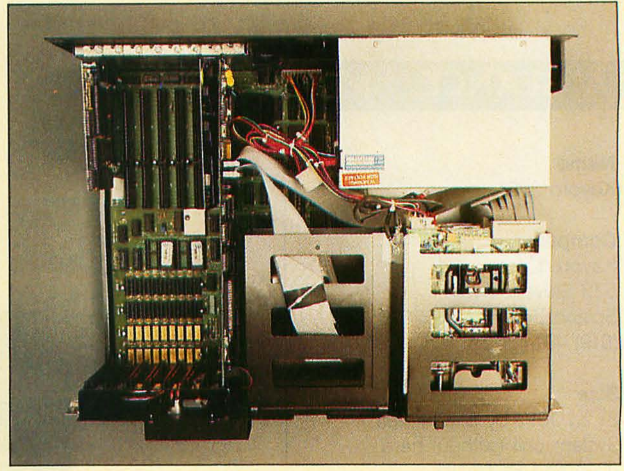




The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity for a single floppy-disk drive and the maximum standard capacity for each system. The Bundled Software graph shows the number of software packages included with each system. The Price graph shows the list price of a system configured with two drives, a monochrome monitor, graphics and color display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating system for the computers under comparison, and the standard BASIC interpreter. Note that the price of the Kaypro 286i is for the dual floppy-disk-drive system and does not include the cost of the operating system.



The back panel of the Kaypro 286i.



Inside the Kaypro 286i: six slots appear on the left. The review unit included two floppy-disk drives.

DISK ACCESS IN BASIC (SEC)

	KAYPRO 286i	IBM PC	APPLE IIE
WRITE	24	56	37
READ	23	46	36

BASIC PERFORMANCE (SEC)

	KAYPRO 286i	IBM PC	APPLE IIE
SIEVE	73	191	245
CALCULATIONS	22	69	94

SYSTEM UTILITIES (SEC)

	KAYPRO 286i	IBM PC	APPLE IIE
40K FORMAT/DISK COPY	11	9.6	22
40K FILE COPY	8.2	5.8	45

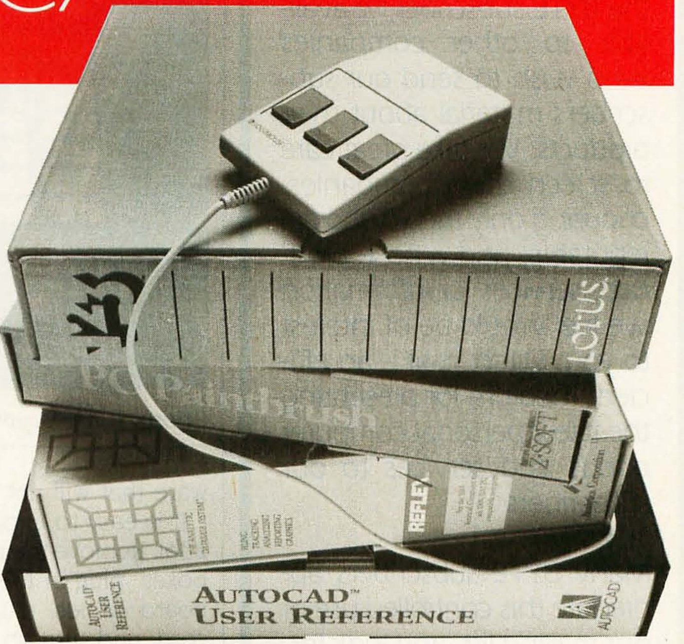
SPREADSHEET (SEC)

	KAYPRO 286i	IBM PC	APPLE IIE
LOAD	7.3	8.1	18
RECALCULATE	4.1	11	22

The graphs for Disk Access in BASIC show how long it took to write and to read a 64K-byte sequential text file to a blank floppy disk. (For the program listings, see BYTE's Fall 1985 special issue, *Inside the IBM PCs*, page 195.) The Sieve graph shows how long it took to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it took to do 10,000 multiplication and 10,000 division operations using single-precision numbers. The System Utilities graphs show how long it took to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Kaypro was tested using the drives in double-density mode. The Spreadsheet graph shows how long it took to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet used was Microsoft Multiplan.

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Photo 1: *The Kaypro 286i keyboard uses the* IBM PC AT *layout.*

ware that will not run on the PC AT.

It is easy to unpack and set up the 286i. Remove the equipment from its boxes, plug in the monitor and keyboard cables, plug in the electrical cord, and turn on the machine. Like the PC AT, the Kaypro includes a small barrel key that fits into a lock on the front panel and switches the keyboard on and off. If you leave the lock in the Ready position, you won't have a problem when you lose the key. Fortunately, Kaypro supplies two keys.

It is easy to hook up a printer to the parallel port at the back of the 286i; Kaypro uses the IBM PC adaptation of the Centronics standard. Unfortunately, the serial port follows the IBM PC AT standard. It is a nine-pin male plug, virtually useless without an extra-cost adapter ($40 retail) that turns it into a standard PC serial port. IBM reportedly used the smaller serial plug so that a serial and parallel port could be placed on the same card. Kaypro picked up the PC AT's bad features along with the good.

The Kaypro's keyboard (see photo 1) uses the same layout as the PC AT, but the Enter key and right-hand Shift keys are a little larger. The PC AT's keyboard has the feel of an IBM PC keyboard, requiring firm pressure on the keytops to enter data. It is also noisy. The Kaypro keyboard requires a softer touch and is much quieter.

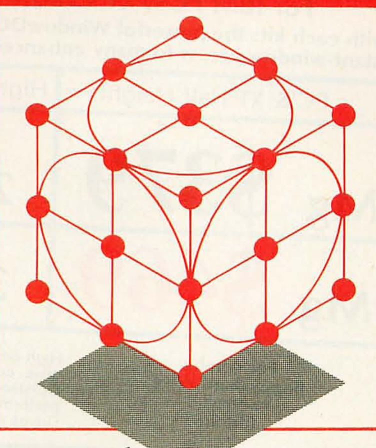
The 14-inch RGB monitor, bundled with the system or available separately for $595, is barely adequate for a machine with the 286i's capabilities. The retail price is high for a monitor with a shadow-mask aperture of only 0.4 millimeters. Characters closely resemble those produced by the IBM graphics adapter/monitor combination, but the letters are coarse; extended use would probably give you eyestrain. Color graphics are adequate, but there are many more reasonably priced RGB displays on the market that will produce better results with characters and graphics than the Kaypro monitor. The monitor has a built-in tilt stand, a minor convenience.

If you're intrigued by the Kaypro 286i as an alternate to the IBM PC AT, I don't think you'll go wrong. I couldn't uncover any hardware incompatibilities. IBM's Enhanced Graphics Adapter and Enhanced Graphics Monitor worked perfectly. And, like the AT, the Kaypro is very fast. When running the System Information routine from The Norton Utilities, the 286i's CPU processes data approximately 5.7 times faster than the Intel 8088-based IBM PC, the same rating as the IBM PC AT. The Kaypro's results on the BYTE benchmarks were similar to the IBM PC AT (see page 220).

The Kaypro 286i is a true compatible with a list price substantially lower than the IBM machine. A careful shopper can save close to $3000 by buying the Kaypro instead of the IBM. ■

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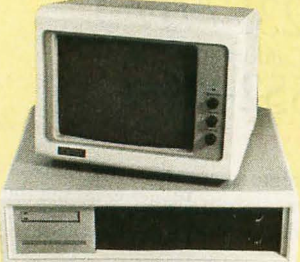
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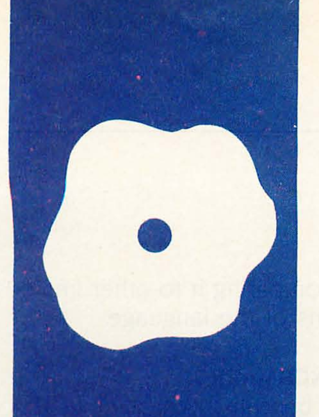
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Modula-2 System for Z80 CP/M

Hochstrasser's package supports most features as defined by Wirth

BY BRIAN R. ANDERSON

The Modula-2 System for Z80 CP/M produced by Hochstrasser Computing AG was written in Zurich, Switzerland, by four graduates of ETH (Federal Institute of Technology), where Niklaus Wirth developed both Pascal and Modula-2. Because of the close association between the author of the language and the authors of this compiler, I had every expectation of a high-quality product that adhered closely to Wirth's definition of Modula-2.

I was not disappointed. This is a full-featured system with extensive library support and a very smooth user interface. Everything seems to be well engineered and relatively bug-free. The system supports virtually all features as defined by Wirth, lacking only processes and monitors. Version control is currently disabled. All features are expected sometime in the future and will be available to registered users at a nominal charge for media and printing. This review refers to version 2.0 of the compiler. The release date was March 28, 1985.

The library modules (most with commented source code) include three separate file systems—two sequential, one random-access; a program chaining system that allows data sharing; full access to both BDOS (basic disk operating system) and BIOS (basic input/output system) calls; math functions (transcendentals); and many others.

HARDWARE

A Z80 CP/M system with at least 52K bytes of RAM (random-access read/write memory) and two disk drives is required. The compiler uses about 170K bytes of disk space. The linker and all its support files (that is, library and utility modules and excluding the source files) take up about 120K bytes. Since the compiler and linker don't have to be present on the system at the same time, it would be possible to work with disk drives as small as 170K bytes. However, to work comfortably, it would be better to have larger drives; Hochstrasser recommends at least 300K bytes each. The Z80 is a must; the compiler will not work with an 8080 or 8085.

My computer system consists of an S-100 single-board computer made by Intercontinental Micro Systems, using a 4-MHz Z80 operating under CP/M 2.2. All tests were done with an 8-inch single-sided single-density (SS/SD) disk as the data disk. The system disk was an 8-inch double-sided double-density (DS/DD) disk.

The documentation that comes with the compiler is quite good. The manual, *Modula-2 System for Z80 CP/M*, is organized so that the first-time user can get up and running quickly.

The first section of the manual explains system requirements and guides you through configuration and a sample compile session (several sample programs are on the disks).

The manual's introduction to Modula-2 provides a good insight into the differences between Modula-2 and Pascal. It is not a replacement for *Programming in Modula-2* by Niklaus Wirth (Springer-Verlag, 2nd edition, 1983), but this introduction is a worthwhile companion to it.

The implementation section explains the use of the compiler in detail and describes the library modules. The description of the compiler is excellent. Although the library description is adequate for most purposes, it is at times sketchy and vague; keep Wirth's book handy. (Another useful companion is *Modula-2 for Pascal Programmers* by Richard Gleaves [Springer-Verlag, 1984]. It is based on the MS-DOS implementation of Modula-2 by Volition Systems, and it describes the library modules in some detail—along with example programs. The Volition and Hochstrasser implementations are very similar, and virtually everything in Gleaves's book applies equally to the Hochstrasser Modula-2.)

Also in the system manual is an advanced

(continued)

Brian R. Anderson (2977 East 56th Ave., Vancouver, British Columbia V5S 2A2, Canada) is a certified engineering technician with experience in communications and industrial control. He works as an instructor at Vancouver Community College. His interests include motorcycling and playing the guitar.

programming guide that has tips and techniques to improve efficiency, interface to assembly-language modules, and other useful information.

Finally, there is a set of appendixes, including an explanation of the linker format, an EBNF (Extended Backus-Naur Form) language definition, and a list of error messages used by the compiler and linker.

EVALUATION

The method I chose to evaluate this compiler was to develop several benchmark programs, each testing a specific feature. Compile time is important to everyone, so all compile times (using automated batch processing) are tabulated for the test programs. Different features are significant depending on your application; therefore, I have evaluated four separate areas for execution speed: integer math, floating-point math, screen output, and file I/O (input/output).

As a concession to tradition, I also include the Sieve of Eratosthenes among the test programs. The Sieve tests the ability to perform loops, but little else.

COMPARISON LANGUAGES

For comparison, I compiled and ran similar programs in Pascal (using Borland International's Turbo Pascal) and in C (using Aztec C). Choice of comparison languages was dictated mostly by what I had available. However, I'll try to justify my choices on technical grounds, too. Since I know of no other Z80 compiler system for Modula-2 (and I've looked), there was no option but to compare with compilers of other languages.

Pascal is closely related to Modula-2, so it seems natural to compare these two. Turbo Pascal is an excellent product, known particularly for its compilation and execution speed.

Both C and Modula-2 are considered to be "systems" languages (that is, useful for writing operating systems). Both have separated scope (visibility) and lifetime (existence) for variables. Both use modules. (C, however, does not formalize this; C's independent compilation units are similar to Modula 2's modules—instead of the import/export lists, C uses the extern concept.) Since C and Modula-2 seem to be vying for the same space, it does not seem unreasonable to compare them. Aztec C has received consistent high marks in reviews comparing it to other implementations of the language.

THE BENCHMARKS

The math benchmarks are simple. The programs execute one operation repeatedly; I timed the operation and then divided the total time by the number of repetitions. The result is

Listing 1: *Benchmark to evaluate integer operations.*

```
MODULE MTIMEI;

   FROM Terminal IMPORT   (* standard module as
defined by Wirth *)
      Write, WriteLn, WriteString;

   FROM ASCII IMPORT
      bel;

   VAR
      x, y, z : INTEGER;
      i : CARDINAL;


   PROCEDURE Delay (x : CARDINAL);    (*
variable Delay, x in milliseconds *)

      VAR
         i, j : CARDINAL;

      BEGIN
         FOR i := 1 TO x DO
            FOR j := 1 TO 18 DO
            END;
         END;
      END Delay;


BEGIN
   x := 11;   y := 2;

   WriteString ('Blank');   WriteLn;
   Delay (500);
   Write (bel);
   i := 1;
   REPEAT
      z := y;
      i := i + 1;
   UNTIL i = 10000;
   Write (bel);
   Delay (4000);

   WriteString ('Addition');   WriteLn;
   Delay (500);

   Write (bel);
   i := 1;
   REPEAT
      z := x + y;
      i := i + 1;
   UNTIL i = 10000;
   Write (bel);
   Delay (4000);
```

the time taken to perform that operation once. To factor out overhead for the loop and assignment portion of the operation, I also included a blank loop in the tests. I subtracted the time for this blank loop from the other times before calculating time per operation. See listing 1 (Integer) and listing 2 (Floating Point). [*Editor's note: All programs shown here are available for downloading from* BYTEnet Listings, (617) 861-9764, *or on disk (see page* 358 *for details).*]

This compiler implements floating-point math in a single-precision format, which is similar to that proposed by IEEE (Task 754, 1981), and pro-

(continued)

```
    WriteString ('Subtraction');   WriteLn;
    Delay (500);
    Write (bel);
    i := 1;
    REPEAT
       z := x - y;
       i := i + 1;
    UNTIL i = 10000;
    Write (bel);
    Delay (4000);

    WriteString ('Multiplication');   WriteLn;
    Delay (500);
    Write (bel);
    i := 1;
    REPEAT
       z := x * y;
       i := i + 1;
    UNTIL i = 10000;
    Write (bel);
    Delay (4000);

    WriteString ('Division');   WriteLn;
    Delay (500);
    Write (bel);
    i := 1;
    REPEAT
       z := x DIV y;
       i := i + 1;
    UNTIL i = 10000;
    Write (bel);
    Delay (4000);

    WriteString ('Modulus');   WriteLn;
    Delay (500);

    Write (bel);
    i := 1;
    REPEAT
       z := x MOD y;
       i := i + 1;
    UNTIL i = 10000;
    Write (bel);
    Delay (4000);

    WriteString ('Good-bye...');   WriteLn;
 END MTIMEI.
```

vides about 7 significant digits. This degree of precision is useful for many applications, but round-off error can build up quickly if your application requires much iteration. As an example, I calculated factorials (both recursively and iteratively) and found the error could become excessive after about 11 iterations. With no iteration, the transcendental functions appear to be accurate to the full 7 digits provided. All the usual functions are included (sin, cos, arctan, exp, ln), plus a power function and two conversion functions (REAL to INTEGER and INTEGER to REAL).

Note that both Turbo Pascal and Aztec C implement their floating-point operations in double-precision.

The third benchmark tests console screen output speed—specifically the time taken to completely rewrite the screen with "The quick brown fox. . . ." Rapid screen update is particularly important for writing programs such as text editors or anything that makes extensive use of console I/O. In all cases, the console was operating at 19,200 bits per second. The screen output program is shown in listing 3.

The final benchmark involved disk file I/O (listing 4); it's a simple file-copy program, ostensibly to create a backup file. The text file copied was 100 lines of "The quick brown fox. . ."—7K bytes in total.

Listing 5 shows the Sieve program as implemented in this review.

Statistical results for the mathematical benchmarks are given in table 1. All other benchmark statistics are given in table 2.

I did not encounter any bugs in the compiler or linker, although some were reported at the beta test sites and have been corrected with release of version 2.0. I did come across two errors in the library/utility modules; these also have been corrected in the latest release.

As the tables show, Modula-2 fared quite well in most benchmark categories. Although compile times were much slower than for Turbo Pascal, they were similar to those of Aztec C.

(continued)

Listing 2: *Benchmark to evaluate floating-point operations.*

```
MODULE MTIMEF;    (* times floating point
operations *)

   FROM Terminal IMPORT
      Write, WriteLn, WriteString;

   FROM MathLib IMPORT
      sin, cos, arctan, ln, exp;

   FROM ASCII IMPORT
      bel;

   VAR
      x, y, z : REAL;
      i : CARDINAL;


   PROCEDURE Delay (x : CARDINAL);    (*
variable delay, x in milliseconds *)

      VAR
         i, j : CARDINAL;

      BEGIN
         FOR i := 1 TO x DO
            FOR j := 1 TO 18 DO
            END;
         END;
      END Delay;


BEGIN
   x := 12.5;    y := 0.5;

   WriteString ('Blank');    WriteLn;
   Delay (500);
   Write (bel);
   i := 1;
   REPEAT
      z := y;
      i := i + 1;
   UNTIL i = 10000;
   Write (bel);
   Delay (4000);

   WriteString ('Addition');    WriteLn;
   Delay (500);
   Write (bel);
   i := 1;
   REPEAT
      z := x + y;
      i := i + 1;
   UNTIL i = 10000;
   Write (bel);
   Delay (4000);

   WriteString ('Subtraction');    WriteLn;
   Delay (500);
   Write (bel);
   i := 1;
   REPEAT
      z := x - y;
      i := i + 1;
   UNTIL i = 10000;
   Write (bel);
   Delay (4000);
```

```
WriteString ('Multiplication');   WriteLn;
Delay (500);
Write (bel);
i := 1;
REPEAT
   z := x * y;
   i := i + 1;
UNTIL i = 10000;
Write (bel);
Delay (4000);

WriteString ('Division');   WriteLn;
Delay (500);
Write (bel);
i := 1;
REPEAT
   z := x / y;
   i := i + 1;
UNTIL i = 10000;
Write (bel);
Delay (4000);

WriteString ('Sine');   WriteLn;
Delay (500);
Write (bel);
i := 1;
REPEAT
   z := sin (y);
   i := i + 1;
UNTIL i = 1000;
Write (bel);
Delay (4000);

WriteString ('Cosine');   WriteLn;
Delay (500);
Write (bel);
i := 1;
REPEAT
   z := cos (y);
   i := i + 1;
UNTIL i = 1000;
Write (bel);
Delay (4000);

WriteString ('Arctangent');   WriteLn;
Delay (500);
Write (bel);
i := 1;
REPEAT
   z := arctan (x);
   i := i + 1;
UNTIL i = 1000;
Write (bel);
Delay (4000);

WriteString ('Natural Log');   WriteLn;
Delay (500);
Write (bel);
i := 1;
REPEAT
   z := ln (x);
   i := i + 1;
UNTIL i = 1000;
Write (bel);
Delay (4000);
```

(continued)

```
    WriteString ('Natural Antilog');   WriteLn;
    Delay (500);
    Write (bel);
    i := 1;
    REPEAT
       z := exp (y);
       i := i + 1;
    UNTIL i = 1000;
    Write (bel);
    Delay (4000);
END MTIMEF.
```

Listing 3: *Benchmark to test screen I/O execution.*

```
MODULE MSCREEN;

   FROM TERM1 IMPORT   (* nonstandard terminal
module *)
      Write, WriteCard, WriteString, WriteLn;

   FROM ASCII IMPORT
      bel, sub;

   VAR
      i : CARDINAL;


BEGIN
   Write (sub);   (* Clear Console Screen *)
   Write (bel);

   FOR i := 1 TO 100 DO
      WriteCard (i, 3);
      WriteString (' The quick brown fox jumped
over the lazy dogs back.  ');
      WriteString ('1234567890');   WriteLn;
   END;

   Write (bel);
END MSCREEN.
```

Listing 4: *Benchmark to test disk I/O.*

```
MODULE MFILECPY;

   FROM SeqIO IMPORT
      FILE, FileState, Open, Create, Close,
Read, Write, EOF;

   FROM Terminal IMPORT
      ReadString, WriteLn, WriteString;

   FROM Strings IMPORT
      STRING;


   VAR
      inFILE, outFILE : FILE;
      name, BAKname : STRING; (* filenames *)
      c : CHAR;
```

Code size is where Modula-2 really excelled, at times bettering the competition by a ratio of 5 to 1. Execution times were similar throughout, with a slight edge going to Modula-2, on average.

Ease of Use

In most ways, Modula-2 for Z80 CP/M runs smoothly and is exceedingly easy to use. The system consists of a four-pass compiler and a two-pass linker. The multipass design results in tight, efficient code and acceptable compile speed, considering the results. Several useful compile switches are provided (for example, assembly output or listing-file output), but not so many that they are hard to remember.

The compiler has two methods of handling errors. The default mode automatically creates a listing file (complete with page breaks, headers, and line numbers), with error messages embedded. A "star bar" flags the line where an error occurs, while a pointer shows the position within the line. A compiler switch allows errors to be handled in a simpler manner: The lines and positions of errors are output to the console. Errors are tagged with uncanny accuracy, and I seldom got an error message that did not make sense.

Errors are noted by numbers, which you must look up in the system manual. I did manage to invoke an error that is not listed in the manual—Error 332 was caused by trying to EXIT from a WHILE statement. This error should have been Error 151 according to the manual. In Modula-2, EXIT is allowed only from a LOOP statement. I guess I've been tainted by C, where you can break (as C calls it) from nearly anything.

The compiler and linker have an excellent system that allows them to find their respective source files no matter what drive they are located on. You can easily customize the search path at installation. With the module concept, such a path search is nearly essential, since you are certain to have modules on more than one disk (sys-

(continued)

```
   PROCEDURE MakeBAK (in : STRING; VAR out :
STRING; tag : STRING);
      VAR
         i, j : CARDINAL;
      BEGIN
         i := 0;
         WHILE (in[i] # 0C) AND (in[i] # '.')
DO
            out[i] := in[i];
            INC (i);
         END;

         j := 0;
         WHILE tag[j] # 0C DO
            out[i] := tag[j];
            INC (i);  INC (j);
         END;

         out[i] := 0C; (*add NULL terminator*)
      END MakeBAK;

BEGIN
   WriteString ('File Backup Utility');
WriteLn;  WriteLn;
   WriteString ('Enter filename: ');
   ReadString (name);  WriteLn;
   MakeBAK (name, BAKname, '.bak');

   IF Create (outFILE, BAKname) = FileOK THEN
      IF Open (inFILE, name) = FileOK THEN
         WHILE NOT EOF (inFILE) DO
            Read (inFILE, c);
            Write (outFILE, c);
         END;

         IF (Close (inFILE) <> FileOK) OR
(Close (outFILE) <> FileOK) THEN
            WriteString ('Error closing
files...');  WriteLn;
         ELSE
            WriteString (BAKname);
WriteString (' completed.');  WriteLn;
         END;
      ELSE
         IF Close (outFILE) <> FileOK THEN
            (* do nothing *)
         END;
         WriteString ('Error creating new
file...');  WriteLn;
      END;
   ELSE
      WriteString ('Error opening file...');
WriteLn;
   END;
END MFILECPY.
```

tem modules on the compiler disk and your modules on the work disk).

Due to a small quirk in the compiler, the object files are always written to the default drive (usually the system or A drive). A great improvement would result if the object files were written (or could be redirected) to the disk where the main source file was found. Maybe it's me that has the quirk, but you be the judge. I think the A drive should have the compiler system on it, and the B drive should have the source and object files.

The best solution I could find was to create three separate CP/M SUBMIT files; one to compile program modules (on the B drive), one to compile definition and implementation modules on the B drive, and one to compile definition and implementation modules on the A drive. Shown below are the three SUBMIT files, along with an explanation of each. Contents of file modula.sub are

```
MC $1 /V /X
ML $1 /V /O:B:$1
ERA $1.MRL
```

MC invokes the compiler in the verbose mode (/V) and terminates batch processing (/X) if there are any compile errors. As usual with CP/M SUBMIT files, $1 specifies the first command-line argument (in this case the source filename, without the file type).

ML invokes the linker (also in the verbose mode), with the object file redirected to the B drive (/O). The /O option allows you to specify the object filename of the linker. Here, the filename itself is the same as the source filename, with the drive specifier forced to B. Linker output is a .COM file.

ERA erases the relocatable file (.MRL) output by the compiler. This file is used by the linker and is then no longer needed (at least in the case of stand-alone programs). This prevents .MRL files from cluttering up the system disk.

File DefImp/B.SUB contains

```
MC $1.DEF /V /X
MC $1.MOD /V /X
PIP B:=A:$1.*
ERA $1.MSY
ERA $1.MRL
```

Definition and implementation modules are compiled separately. The PIP command moves the .MSY (Modula symbol) and .MRL (Modula relocatable) files to the B drive before the unwanted copies on drive A are erased.

File DefImp/A.SUB contains

```
MC $1.DEF /V /X
MC $1.MOD /V
```

When compiling to the system disk (for example, compiling library modules), definition and implementation modules are compiled separately and left on A. Two examples follow. To compile the program module sieve.mod, all that is required is

A>submit modula sieve <CR>

To compile definition and implemen-

(continued)

Due to a small quirk in the compiler, the object files are always written to the default drive (usually the system or A drive).

Listing 5: *Sieve of Eratosthenes benchmark written in Modula-2.*

```
MODULE MSIEVE;

    FROM TERM1 IMPORT
        WriteString, WriteCard, WriteLn;

    CONST
        Size = 8190;                (* size of
array *)
        Iterations = 10;            (* minimum 1 *)

    VAR
        count, i, iter, k, prime : CARDINAL;
        flags : ARRAY [0..Size] OF BOOLEAN;

BEGIN
    WriteString ('10 Iterations');   WriteLn;
    FOR iter := 1 TO Iterations DO
        count := 0;

        FOR i := 0 TO Size DO
            flags[i] := TRUE;
        END;

        FOR i := 0 TO Size DO
            IF flags[i] THEN
                prime := i + i + 3;
                k := i + prime;
                WHILE k <= Size DO
                    flags[k] := FALSE;
                    INC (k, prime);
                END;
                INC (count);
            END;
        END; (* FOR *)
    END; (* FOR *)

    WriteString ('There were ');
    WriteCard (count, 0);   WriteString ('
primes.');
END MSIEVE.
```

AT A GLANCE

Name
Modula-2 System for Z80 CP/M

Company
Hochstrasser Computing AG
Chratzstrasse 14
8954 Geroldswil
Switzerland

Format
Three SS/SD 8-inch distribution disks; not copy-protected

Computer
Z80-based CP/M system with 52K bytes of RAM required, two floppy-disk drives holding at least 300K bytes each recommended

Documentation
User's manual, 240 pages with index

Price
$160

tation modules for NEWMOD to the B drive.

A>submit DefImp/B newmod <CR>

CONCLUSIONS

These lads from Zurich have done an excellent job of implementing Modula-2 on a Z80. All features operated extremely well. The documentation is good and quite complete. I have no hesitation in recommending this system to anyone interested in working with Modula-2. I stress *working*—this is not a toy compiler. Because of the small code size, this system would be suitable even for small control applications. The compiler produces native Z80 code that is ROMable and reentrant. Because of the program chaining facilities, very large applications greater than 64K bytes can also be easily developed. At this time, Modula-2 System for Z80 CP/M is available only on standard 8-inch SS/SD (IBM 3740) disks. Other formats reportedly are coming soon. ■

Table 1: *Results of math benchmarks. Execution times are in milliseconds. Compile times are in minutes:seconds. For the floating-point benchmarks, Modula-2 uses 7 significant digits, Turbo uses 10, and Aztec C uses 14.*

Integer Operations

Test	Modula-2	C	Pascal
+	.007	.04	.01
−	.011	.05	.01
*	.06	.27	.14
DIV	.36	.55	.43
MOD	.32	.54	.41
Compile time (TIMEI)	1:38	1:44	0:08
.COM file	2K bytes	9K bytes	8K bytes

Floating-Point Operations

Test	Modula-2	C	Pascal
+	.29	.42	.34
−	.33	.50	.38
*	.76	11.60	1.60
/	1.20	18.10	2.20
sin	9.50	162.00	22.00
cos	9.30	196.00	23.00
atn	7.20	190.00	19.00
ln	9.30	184.00	26.00
exp	10.70	149.00	23.00
Compile time (TIMEF)	2:01	2:18	0:07
.COM file	6K bytes	15K bytes	9K bytes

Table 2: *Results of I/O and Sieve benchmarks. Execution times are in milliseconds. Compile times are in minutes:seconds.*

Screen Update

	Modula-2	C	Pascal
Execute	1.1	2.1	1.1
Compile time (SCREEN)	1:25	1:27	0:06
.COM file	2K bytes	11K bytes	8K bytes

File Copy

	Modula-2	C	Pascal
Execute	15.2	14.7	25.1
Compile time (FILECPY)	1:52	1:46	0:08
.COM file	8K bytes	12K bytes	8K bytes

(Note: PIP copied the same file in 10.2 seconds.)

Sieve of Eratosthenes

	Modula-2	C	Pascal
Execute	18.4	23.2	22.1
Compile time (SIEVE)	1:25	1:12	0:06
.COM file	2K bytes	8K bytes	8K bytes

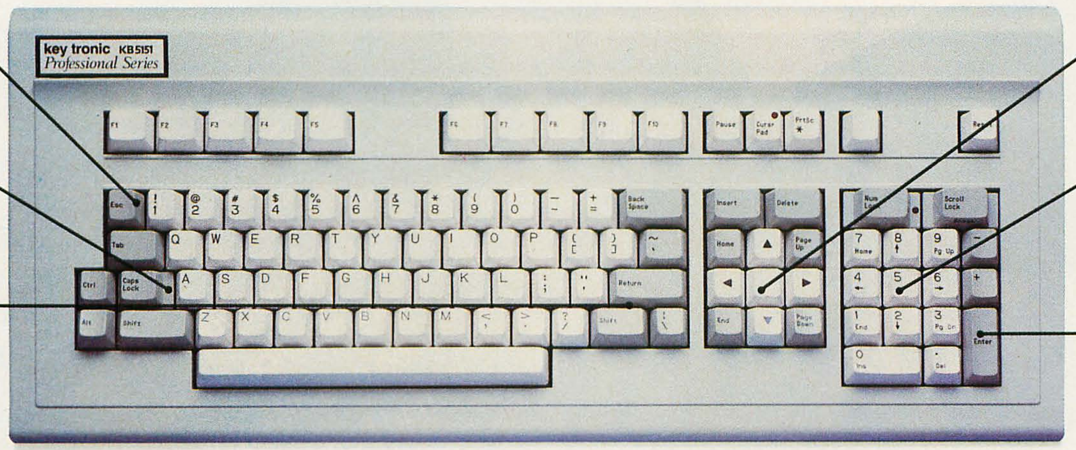


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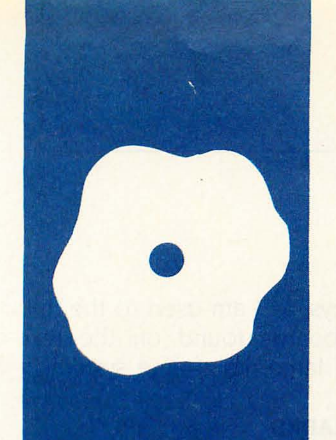
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Pocket APL

An inexpensive yet complete version of the language

BY ERIC H. JOHNSON

Despite the great popularity that APL has gained in recent years, it has remained out of the reach of many microcomputer owners because implementations have been too costly and often required special hardware (such as an 8087 numeric coprocessor) and a special character ROM (read-only memory). Now, however, STSC Inc. has released a reasonably priced, very friendly package for the IBM Personal Computer that runs with as little as 128K bytes of memory and requires no special hardware. Aptly named Pocket APL, it is a complete implementation of APL that incorporates extended system and file functions, a comprehensive on-line help facility, and sample workspaces all on a single disk—and with plenty of room to spare. The introductory tutorial that comes with the package is superb, and there are adequate reference materials, including a user's manual and placards containing the keyboard layout as well as keyword and symbol references.

Pocket APL is aimed at programmers who are beginning to learn APL or who intend to write only small applications. Its only serious disadvantage is that its workspace area is limited to 64K bytes, regardless of how much memory you have. If you require a more powerful APL system, STSC's APL*PLUS/PC offers complete memory utilization, full-screen editing, graphics, and many more features, but for a considerably higher price. On the other hand, if for now you are interested in learning APL but aren't sure about making the investment in a more robust package, then Pocket APL is definitely the way to go. It is by no means a professional package, but you will be surprised at some of its capabilities nonetheless.

Pocket APL comes with some full-screen editing capabilities. However, the insert and delete functions are extremely sluggish, especially with the color/graphics adapter, and there is no "true" insert mode; you must hit the insert key once for every character that you want to put in a line. For editing user-defined functions, you can use the screen editor along with the "del" editor, a version of the editor found on most APL systems. Its operation is quite straightforward, but when used with the screen editor, it is helpful only for line insertion and deletion. As primitive as it is, the screen editor is much more effective for in-line editing.

Pocket APL supports the use of both APL component files and regular DOS files. APL component files are a powerful tool: They allow entire matrices (either numeric or character) to be stored as easily as if they were single elements, relieving you of the burden of having to restructure data. Components may be accessed randomly, and components may be of both numeric and character type within the same file. Unfortunately, Pocket APL imposes a severe restriction on the size of component files; I could not create one greater than about 10K bytes in size. (This was for an entire file, not just one component of a file.)

File operations are performed through special system functions, and there are many more system functions and commands to control the Pocket APL environment in general. These make for a versatile system, but they can be confusing for a first-time user, especially with their unusual (but very consistent) syntax. The syntax of system functions is the same as the syntax of APL's other functions, with the exception that system functions are designated by an English keyword preceded by a "quad box" symbol.

When you enter APL from DOS, the system asks you whether you would like to use APL symbols or their equivalent keywords, and you may switch between the two at any time during your session. The keywords can be used with either the monochrome or the color/graphics adapter card, but I only recommend you use the symbols if you have the latter. For monochrome boards, the standard PC character set is shuffled

(continued)

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around a bit in a good attempt to reproduce the APL symbols, but many of them aren't there. If just starting out in APL, you may want to use the keywords, but this feature is rather awkwardly implemented. The keywords can interfere with user-defined functions, and they are case-sensitive; as you get bogged down in their use, the brevity of the symbols looks much more attractive. If you come to like APL and are not bothered by Pocket APL's limited environment, then you may want to install an APL character ROM, available from STSC for $35. The APL symbols do not interfere with standard ASCII characters, as only some of the more obscure foreign-language characters are displaced. It is available for the Hercules monochrome board as well as IBM's standard.

Pocket APL comes with a keyboard reference placard that you can lean up against your monitor or system unit. This is fine if you are a touch-typist, because all you have to do is glance at the placard and touch the key where you see the symbol. However, if you are a hacker type (such as myself) who never took typing classes, you have to look at the placard and then at the keyboard to locate the key. I would prefer little decals that stick on the keys, as I am used to the full APL keyboards found on the terminals of large mainframe systems.

Table 1: *Benchmark times for Pocket APL and IBM BASICA 2.00. The Disk Read and Write benchmarks were shortened to account for Pocket APL's limited file capabilities. For benchmarks involving real numbers, both Pocket APL and BASIC used double precision unless otherwise noted. (Times are in minutes:seconds.)*

Test	Pocket APL	BASICA
Integer summation, 1 to 10,000	0:25.4	0:39.2 (single precision)
Create 10,000-element array of random integers	0:3.6	0:1:13.0
Find largest element of 10,000-element integer array	0:19.8	0:52.0
Sort 100-element integer array in ascending order	0:0.1	0:59.0
Disk Write (shortened)	0:4.1	0:12.0
Disk Read (shortened)	0:1.3	0:10.0
Sieve of Eratosthenes	3:34.0	3:27.0
Calculations	7:18.0	4:14.0
Summation of sin function values (1–360 degrees)	0:12.1	0:19.0

Listing 1: *Summation of the integers 1 to 10,000 in (a) APL and (b) BASIC.*

(a)

```
+/ ⍳10000
```

(b)

```
5 REM Summation of integers 1 to 10000
10 SUM=0
20 FOR I=1 TO 10000
30     SUM=SUM+I
40 NEXT I
50 PRINT "Done. Sum= ";SUM
60 END
```

BENCHMARKS

Although Pocket APL does not have the mind-numbing speed of APL implementations with 8087 numeric coprocessors, it does a good job of holding its own against other interpreted languages. To test the performance of Pocket APL, I ran benchmark tests between it and another popular language, IBM's BASICA 2.00. (It is difficult to compare APL with any other language, so I chose the language that I felt was the best known among PC owners.) Where APL could be applied appropriately, the functions were much shorter than the BASIC programs to perform the same task. The benchmarks were run under DOS 2.1 on an IBM PC (see table 1).

First, let's consider some basic operations. The summation of the integers 1 to 10,000, while a bit simple-minded for a benchmark comparison, will allow me to point out the major differences between the way APL and BASIC perform their operations and allocate memory. The BASIC program for this task is simple enough; it is essentially a FOR-NEXT loop, taking five statements. The APL version, however, is far more concise (see listing 1) and yields the answer more quickly. This was not as surprising as one other difference: Pocket APL responded with a clean 50005000, but BASIC came back with an inexact 5.00029E+07. Using double precision in BASIC gave the correct answer, but it took a full 8 seconds more than with single precision, chugging through in 47.3 seconds. In APL, all floating-point numbers are double precision by default.

In listing 2, I compare some elementary APL array operations with the same operations in BASIC. As you can see, not only are the APL versions of these operations much more succinct, but they execute much faster, due to the much lower interpreter overhead. One of the most powerful operators in APL is the "upgrade," used in sorting numeric arrays. Curiously enough,

it took much less time to sort a 10,000-element array than it did to find its greatest element. The sort program written in BASIC is a form of the selection sort, a common algorithm that requires, for an array of n elements, n^2/2 iterations to complete. More efficient algorithms (particularly those involving recursion) cannot be implemented in BASIC without a great deal of complication, so I had to choose something less powerful. For direct comparison I used an array of size 100. (I had attempted using an array of size 10,000, which Pocket APL still handled very well. The BASIC program, on the other hand, got hopelessly bogged down in the selection sort and I finally stopped the program after about 17 minutes, at which point the variable I of the outer FOR loop had only reached a value of 13.)

These examples show one of the advantages of using APL, in terms of time, accuracy, and the generality of solutions (also see the text box "APL's Flexibility" on page 243). But APL also has a dark side. While the BASIC program and variables for the first example occupied only 132 bytes of memory, Pocket APL hogged nearly 20K bytes to do the same job. This was the consequence of APL's not having to construct a loop to perform the summation; it had to generate a 10,000-element array containing the numeric sequence and then perform the summation over the array. (In this case, the memory occupied by the array was released back into the workspace because I did not create a variable with it.) This is why Pocket APL's small workspace is such a disadvantage. APL can be so memory-intensive that in a small system, even simple array operations can take up all available memory if the arrays are large enough.

This memory restriction made itself emphatically clear when I tried to run some of the standard benchmarks required of BYTE reviews; the arrays generated by the operations quickly inundated the small workspace, and in each case, all I received for my pro-

(continued)

Listing 2: *Elementary array operations in APL: (a) generates a 10,000-element random integer array, (b) finds the largest element of the array, and (c) sorts it in ascending order. The associated code fragments in BASIC are shown in (d), (e), and (f).*

(a)

```
A ← ? 10000 ρ 10000
```

(b)

```
⌈ / A
```

(c)

```
A ← A [ ⍋ A ]
```

(d)

```
5 REM Generate a 10,000-element array
      of random integers.
10 DIM A%(10000)
20 FOR I=1 TO 10000
30    A%(I)=1+10000*RND
40 NEXT I
50 END
```

(e)

```
5 REM Find the largest element
      of an array.
6 REM Assume existence of 10,000-element
      array A%.
100 X%=A%(1)
110 FOR I=2 TO 10000
120     IF X%<A%(I) THEN X%=A%(I)
130 NEXT I
140 PRINT "Done. Largest element= ";X%
150 END
```

(f)

```
5 REM Array sort using selection algorithm.
6 REM Assume existence of 100-element
      array A%.
100 FOR I=1 TO 100
110     FOR J=1 TO 100
120         IF A%(J)<A%(I) THEN T=A%(I):
                A%(I)=A%(J):A%(J)=T
130     NEXT J
140 NEXT I
150 PRINT "Done."
160 END
```

AT A GLANCE

Name
Pocket APL

Type
Language

Company
STSC Inc.
2115 East Jefferson St.
Rockville, MD 20852
(301) 984-5123

Computer
IBM PC, IBM PCjr, and some PC-compatibles equipped with PC-DOS or MS-DOS; requires at least 128K bytes of memory; IBM PC graphics board required for APL soft character set

Documentation
APL is Easy!, a 173-page tutorial; 22-page reference manual; keyword reference card; APL keyboard placard

Price
$95 ($5 shipping)

gramming efforts was an unceremonious WS FULL (workspace full) message. To avoid this, I either had to "scale down" the benchmark programs or formulate iterative solutions, which I found to be quite frustrating. Another problem was with the component files (for the reasons I mentioned earlier).

The standard benchmarks used were Disk Read and Disk Write, Calculations, and the ubiquitous Sieve of Eratosthenes (see listing 3). The results summary indicates that in cases where APL could be used most appropriately, it was appreciatively faster than BASIC. However, where APL had to be applied iteratively, as in the Sieve and Calculations benchmarks, BASIC gave it a hard time. In fact, if you compare the code for each case, you will see that as the degree of iteration increases, the slower APL performs. While in the Sieve function some degree of parallelism could be maintained, there were no parallel operations whatsoever in the Calculations function, where APL did the worst, although it did return an error of zero. To further test the precision of APL's floating-point operations, I

(continued)

Listing 3: *The standard benchmarks in* APL: *(a) is the Disk Write benchmark, (b) is the Disk Read benchmark, (c) is the Sieve benchmark, and (d) is the Calculations benchmark. Note that programs (a) and (b) had to be modified to fit Pocket APL's file-size limitations (see text). For the* BASIC *versions of these programs, see the* June 1984 BYTE, *page* 327, *and* October 1984, *page* 33.

(a)

```
        ∇DISKWRITE[⎕]∇
[0]   DISKWRITE;A;B
[1]   ⍝ Diskwrite benchmark
[2]   ⍝
[3]   ⍝ Create A, an 8 element character vector
[4]   A←'12345678'
[5]   ⍝ Create B, a 96 by 96 element character matrix
[6]    B← 96 96 ⍴A
[7]   ⍝ Create file 'TEST', with tie number 1
[8]    'TEST' ⎕FCREATE 1
[9]   ⍝ Write B to the first component of TEST
[10]   B ⎕FAPPEND 1
[11]  ⍝ Close file TEST
[12]   ⎕FUNTIE 1
```

(b)

```
        ∇DISKREAD[⎕]∇
[0]   DISKREAD
[1]   ⍝ Diskread benchmark
[2]   ⍝
[3]   ⍝ Open file TEST with tie number 1
[4]    'TEST' ⎕FTIE 1
[5]   ⍝ Read B from first component of TEST
[6]    B←⎕FREAD 1 1
[7]   ⍝ Close file TEST
[8]    ⎕FUNTIE 1
```

(c)

```
      ∇SIEVE[⎕]∇
[0]   Z←SIEVE N;FLAGS;I;ILIMIT;PRIME;K;SETZERO
[1]   ⍝ Perform first iteration of Sieve of Eratosthenes.
[2]   ⍝
[3]   ⍝ Set Index Origin to zero
[4]    ⎕IO←0
[5]   ⍝ Initialize flag array
[6]    FLAGS←(N+1)⍴1
[7]   ⍝ Initialize looping parameters
[8]    ILIMIT←⌊N÷3
[9]    I←0
[10]  ⍝ FOR I←1 TO ILIMIT
[11]  FOR:K←I+PRIME←I+I+3
[12]  ⍝ IF FLAGS[I]=0 THEN NEXT I
[13]   →(0=FLAGS[I])/NEXT
[14]  ⍝ Generate indices to set elements of FLAG to zero.
[15]   SETZERO←+\K,(¯1+⌊(N-I)÷PRIME)⍴PRIME
[16]  ⍝ Set FLAG elements to zero
[17]   FLAGS[SETZERO]←0
[18]  ⍝ NEXT I
[19]  NEXT:→(ILIMIT≥I←I+1)/FOR
[20]  ⍝
[21]  ⍝ Number of primes is equal to number of 1's
        left in FLAG
[22]   Z←+/FLAGS
```

(d)

```
      ∇CALC[⎕]∇
[0]   CALC;A;B;C;I
[1]   ⍝ Calculation benchmark
[2]   ⍝
[3]    A←*1 ⍝ A←Natural log base e
[4]    B←○1 ⍝ B←Pi
[5]    C←1
[6]   ⍝ Initialize looping parameter
[7]    I←1
[8]   ⍝ FOR I←1 TO 5000
[9]   FOR:
[10]   C←C×A
[11]   C←C×B
[12]   C←C÷A
[13]   C←C÷B
[14]  ⍝ NEXT I
[15]  NEXT:→(5000≥I←I+1)/FOR
[16]  ⍝
[17]   'DONE'
[18]   'ERROR= '
[19]   C-1
```

Listing 4: *An illustration of the order of operations in APL. This example calculates a summation over the values of sin(x), where x ranges from 1 to 360 degrees.*

```
          +/1○(÷180)×○⍳360

+/ 1 ○ (÷180) × ○ ⍳360
                  ----     Generate integers 1 through 360

+/ 1 ○ (÷180) × ○ ⍳360
                ------     multiply each by Pi

+/ 1 ○ (÷180) × ○ ⍳360
      ---------------      divide result by 180

+/ 1 ○ (÷180) × ○ ⍳360
   ------------------      take the sine of each element
                           of the result

+/ 1 ○ (÷180) × ○ ⍳360
----------------------     finally, take the sum
                           of the whole.

¯1.193489751E¯15    ←- Answer printed directly
                       by system.
```

made it perform the summation of the sines of the angles 1 through 360, which should yield a null result. (Besides, I could do it noniteratively so as not to offend my sense of purism.) The expression is in listing 4; it is reminiscent of the gloriously undecipherable "one-liners" that are the experienced APL programmer's claim to fame. These are fun once in a while, but I don't recommend that you adopt them generally unless you either document them very well or enjoy solving computational puzzles later on when you've forgotten what you wrote them for.

DOCUMENTATION

The introductory tutorial that comes with the package deserves more than the passing mention I gave it earlier; it is truly excellent. *APL is Easy!* by Jerry R. Turner offers newcomers a straightforward introduction to the language. Its only flaw is that it assumes you are at once familiar with the APL keyboard, which for new users can be terribly confusing. A general overview of each chapter is given in the introduction, and the format of the tutorial is clearly explained. There are exercises at the end of each chapter (with solutions in the back of the book) and examples galore. The sample programs in the book are even on the system disk so you don't have to type them in. *APL is Easy!* will not teach you everything there is to know about APL, but it will give you an excellent working knowledge and a very solid base upon which you can further develop your skills.

In addition to the tutorial is a 22-page reference guide containing summaries of APL and system features. Like the tutorial, it is well

organized and its format is explained in the introduction.

If you require assistance with APL on line, the system help facility is very useful. The panic button is F6; when you press it, the screen clears and is filled with the names of the various topics (there are 35 of them). To see information on a topic, just move the cursor to where you see it listed and hit the enter key; the screen for that topic then appears, and there are often subtopics to choose from.

CONCLUSION

Although Pocket APL has some maddening limitations, STSC should be applauded for creating an APL package that is intended for the general PC user. It's terrific for quick-and-dirty calculations, and the fact that it runs on an unmodified PC makes it even more attractive. If, however, you are an experienced APL user, you will be disappointed. Many features found in more advanced APL systems are missing, such as groups, shared variables, and auxiliary processors.

The most disappointing part of reviewing Pocket APL was the fact that, since the standard benchmarks could not be implemented in the most appropriate way, it performed very poorly on them. I tell people unfamiliar with APL that it has power and elegance, especially in its handling of arrays.

If nothing else, Pocket APL is a means of exploring an entirely different kind of programming language, one that will make you think about programming in a new and broader sense. Naturally, it is much slower than professional APL packages, particularly for floating-point operations. But since both the workspace size and file capacity are so limited, you will not find yourself using it for serious applications to begin with. You may find that it works well for small numerical applications, but don't push it too hard. ■

APL's FLEXIBILITY

Array operations in APL can be extended to arrays of any dimension. For a one-dimensional array, called a vector, we can find the summation of its elements with the expression +/A, where A is the name of the vector. The number of elements in the vector is of no concern to the programmer; the parameters for controlling the summation are taken care of internally. In BASIC, the summation would have to be handled this way:

```
10 Sum = 0
20 For I = 1 to MaxI
30     Sum = Sum + A(I)
40 Next I
```

If the length of A were to change, the value of MaxI would have to be changed, too. What's worse, if the number of dimensions of A were to change, then more code would have to be added:

```
10 Sum = 0
20 For I = 1 to MaxI
25     For J = 1 to MaxJ
30         Sum = Sum + A(I,J)
35     Next J
40 Next I
```

and so on as the number of dimensions were increased. The values of MaxI and MaxJ (the number of elements along each respective dimension) might have to be changed as well.

In APL, to perform the summation of any numeric array, the expression is +/,A. The comma between the slash and the A acts on the array A by "raveling" it, or taking all its elements and forming a vector for the purpose of the summation.



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Language Features

- Data Types: char, short, int, unsigned, long, float, double
- Data Classes: auto, extern, static, register
- Typedef, Struct, Union, Bit Fields, Enumerations
- Structure Assignment, Passing/Returning Structures

Functions

abs	conbuf	feof	getcseg	isascii	movmem	replace	strcat
asm	conc	ferror	getdseg	iscntrl	open	repmem	strcmp
asmx	cos	fflush	getd	isdigit	outp	rewind	strcpy
atan	cpystr	fgets	putd	islower	peek	right$	strlen
atof	creat	fileno	getdate	isprint	perror	rindex	strncat
atoi	cursblk	filetrap	gettime	ispunct	poke	rmdir	strncmp
atol	curslin	find	geti	isspace	poscurs	scanf	strncpy
bdos	curscol	floor	puti	isupper	pow	setbuf	strsave
bdosx	cursrow	fopen	getkey	itoa	printf	setbufsiz	system
bios	cursoff	fprintf	getmode	keypress	putc	setcolor	tolower
biosx	curson	fputs	setmode	left$	putchar	setdate	toupper
calloc	delete	fread	gets	len	puts	settime	ungetc
ceil	drand	free	getw	log	putw	setjmp	ungetch
cfree	exec	freopen	heapsiz	log10	rand	setmem	unlink
chain	execl	fscanf	heaptrap	longjmp	read	sin	write
character	execv	fseek	hypot	lseek	readattr	sound	writechs
chdir	exit	ftell	index	malloc	reach	sprintf	xmembeg
chmod	exitmsg	fwrite	inp	alloc	writech	sqrt	xmemend
clearerr	exp	getc	insert	mathtrap	readdot	srand	xmemget
close	fabs	getch	iofilter	mid$	writedot	sscanf	xmemput
clrscrn	fclose	putch	isalnum	mkdir	realloc	stacksiz	xmovmem
cmpstr	fdopen	getchar	isalpha	modf	rename	str$	_exit

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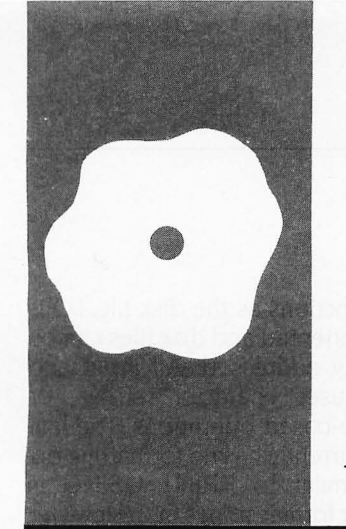
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SOFTWARE REVIEW

Arity/Prolog

An excellent microcomputer version of Prolog

BY WILLIAM G. WONG

Arity/Prolog is an implementation of Prolog for MS-DOS systems, one that matches implementations found on a number of mainframes.

The base version of Arity/Prolog includes the Prolog interpreter and is available for $350. You can purchase a native-code compiler with the interpreter for $795. (I reviewed version 3.2; see the text box "Arity/Prolog 4.0" on page 247 for a look at the recently announced version.) The compiler can generate code for stand-alone programs or code that you can use with the interpreter. There are no license fees for stand-alone programs. Compiled Prolog code has all the advantages of conventionally compiled code, including faster execution.

COPY PROTECTION

Arity/Prolog is a great product, as the rest of this article will show. However, it has what I consider one major problem: copy protection using a key-disk system. This only applies to the interpreter and compiler. Stand-alone programs do not have copy protection.

You must have the key disk in drive A when you initially run the programs, even on a hard-disk system. Also, you get only one key disk and nothing runs without it. I would hate to have the key disk fail in the middle of important research or writing.

DOCUMENTATION

Arity/Prolog comes in a nice vinyl binder with two books entitled *The Programming Language* and *The Programming Environment*. Arity Corporation expects to have new documentation in the near future. The existing documents are good and include appendixes and an index.

The Programming Language describes the implementations of Arity/Prolog, including all functions built into the system. This book contains a number of good examples but is not intended to be a tutorial. The only item not covered in enough detail is the tail-recursion optimization.

The Programming Environment describes how to use the interpreter, compiler, and utility programs. It also describes the assembly-language and Lattice C interface and has a detailed presentation of the Prolog internals. The organization and examples are excellent.

DATA TYPES

Arity/Prolog has a number of different basic data types, including 16-bit integers, floating-point numbers, strings, lists, variables, atoms, and structures. It lets you manipulate integers and floating-point numbers using normal arithmetics, logical bit operators, and logarithmic and trigonometric functions. The language uses an 8087 numeric coprocessor for floating-point manipulation if it is resident.

Strings and lists have the usual set of manipulation functions found in languages such as C and BASIC. Strings are character-based vectors, while lists can contain any data type. A string is written with dollar signs as delimiters; double-quote delimiters are reserved for a list of characters. This is different from other languages but does provide the required differentiation. See table 1 for examples of the two types.

Although lists have the advantage of holding an item of any type, the string usually holds text more efficiently. You will often use lists to hold a list of atoms that can be searched quickly. However, Arity/Prolog also provides the string_search function, which allows quick examination of strings for tokens. Multiple occurrences of a string can be found using string_search because it supports backtracking. For example,

```
string_search($xyz$, $xyz abc xyz$, X)
```

would succeed twice with X being instantiated to 0 and 8.

Prolog variables start with a capital letter or an underscore. An underscore alone is the anonymous variable. Atoms are constants and start with a lowercase letter or

(continued)

William G. Wong (Logic Fusion Inc., 1333 Moon Dr., Yardley, PA 19067) *is president of Logic Fusion Inc. and a developer of systems and applications software.*

are enclosed in single quotes. See table 2 for a list of valid variables and atoms.

Unfortunately, all variables are converted into internal names when they are placed into the database. Internal variable names have an underscore and a hexadecimal number, as in _1CD8. This is an inconvenience only when you use the interpreter because

```
likes( X, some_fruit ) :-
  likes( X, apples ),
  likes( X, oranges ).
```

gets converted to

```
likes( _0123, some_fruit ) :-
  likes( _0123, apples ),
  likes( _0123, oranges ).
```

Structures provide a general-purpose mechanism for describing relationships between terms. The name of a structure, called a *functor*, must be a constant. A structure can have a number of terms listed between parentheses and separated by commas. The functor can be listed by itself if it includes no terms, as in

```
functor_with_no_terms
likes( john, apples )
plural( apple, apples )
kind_of( apple, fruit )
```

The only quirk is that the left parenthesis must be adjacent to the functor. Any intervening spaces indicate that the functor has no terms associated with it. In addition, infix operator precedence can be specified so the previous examples could appear as

```
john likes apples
apple plural apples
apple kind_of fruit
```

Database Support

Arity/Prolog uses a single database containing clauses that are structures. Clauses can be hidden in a modular fashion only if you use the compiler. A complete set of operators is provided for adding and deleting clauses. Any interpreted clauses can be listed to the screen or to a file. This capability is somewhat limited, but you can easily extend it.

In addition, you can save the entire database or restore it from a file very quickly. The save option allows incremental backup. The restore option lets you resume a session in the same condition as it was saved. This process is much faster than reading Prolog text, since information is already placed into the database.

I/O Support

Arity/Prolog supports a wide variety of I/O (input/output) functions for character devices and disk files. You access character devices, such as the console and the printer, by using the same functions as the disk file. I/O is stream-oriented and disk files can be randomly addressed. All input and output uses character-, string-, or structure-based operations. The language currently has no formatting options similar to PRINT USING in BASIC or format strings in C. However, you can convert numbers to strings by using a limited formatting capability, and then you can print them.

The I/O operators can use the standard input and output files or specific file handles. For example,

```
get0(Character)
get0(Handle, Character)
```

shows the use of the character-input operator with the standard input file and a specified file handle. I/O redirection is possible and is described in the documentation. You can perform redirection of the standard input and output files permanently or for the duration of a Prolog goal search.

Arity/Prolog supports the DOS 2.*x* subdirectories and a search-path facility for data files similar to the DOS PATH command. Directory-maintenance operations and subdirectory creation and deletion are also supported.

You can access the screen directly, including cursor-positioning control and character-attribute manipulation. This makes menu presentation much easier. You can also retrieve screen contents, which makes programming menu windows a snap.

Arity/Prolog includes direct access to the I/O ports accessible to the 8088/8086. This lets you create communications or process-control programs in Prolog without using assembly-language functions.

In general, the I/O support is adequate for most AI (artificial intelligence) applications but is limited for general applications that require formatted output. You can access binary files, but this is difficult using the existing operators.

System Access

Direct access to the DOS for non-file-related functions is limited to time functions and invocation of the DOS

Table 1: *Examples of lists and strings in Arity/Prolog.*

Example	Description
[a, b]	Two-element list
.(a, .(b, nil))	Same as [a, b]
$This is a string.$	Normal string
$A dollar sign$$.$	String with embedded $ sign
"abc"	Same as [97, 98, 99]

Table 2: *Arity/Prolog's valid variables and atoms.*

Variables	Atoms
_	anonymous
X	x
__0394	'France'
Sack_of_items	box_of_apples

Command program. The latter lets you run other programs directly from Prolog.

You can directly access the current time and date. Also, the format of the time-stamp structure is the same as that used by the directory-manipulation functions.

Access to DOS interrupts and other system-related functions is possible if you include assembly-language or C functions.

ERROR HANDLING AND TRACING

Arity/Prolog error handling is adequate but different from most languages. It lets you change error messages and turn the error messages for syntax and file I/O on and off. Arithmetic errors cause the evaluation to fail, and any variables involved are bound to the atom err. This is a nice feature when you are dealing with mathematical proofs. All other operations cause the goal to fail.

Only fatal errors, such as insufficient space, will cause the program to abort. This is unfortunate, since the state of the database is lost. Aborting current computation and returning to the top-level prompt or some specified clause would have been preferable.

The trace facility is very good. It includes a single-step-mode option with a number of other options. You can monitor a clause when it is called, when it exits, when it fails, or when backtracking occurs.

The only type of operation not supported by Arity/Prolog is a LISP-style CATCH/THROW including an UNWIND_PROTECT. This would let a computation return a single result without your explicitly declaring such a possibility within a database. It also would provide a better error-handling facility for both fatal system and program-induced errors.

VIRTUAL MEMORY

Virtual-memory support is built into Arity/Prolog, both interpreted and compiled. The Prolog database is automatically moved between a file and main memory as the program requires. Obviously, faster file access leads to faster program execution. Virtual-memory files are impractical on floppy disks, acceptable on hard disks, and very nice with RAM (random-access read/write memory) disks.

Arity supplies a menu-driven environment-definition program to control the operation of the virtual-memory system and a number of other system parameters.

COMPATIBILITY

Arity/Prolog is an extended version of Prolog as found on many mainframes. A recommended Prolog text is *Programming in Prolog* by W. F. Clocksin and C. S. Mellish, which matches Arity/Prolog very well.

Arity/Prolog supports some sophisticated Prolog features, such as infix notation with operator precedence and definite clause grammars (DCGs). This module is very useful for building natural-language parsers.

COMPILER AND ASSEMBLY-LANGUAGE INTERFACE

The compiler is available at additional cost and provides a number of major benefits. You can compile any interpreted program unless it contains string or floating-point constants. However, you can achieve the desired effect by placing these constants in compiled code as atoms along with atom-conversion operators. Even so, this limitation can cause major problems. Additional mechanisms provide a method of defining modules that let you hide internal definitions from other modules. You can reduce name conflicts by using this feature.

Compiled code runs faster than interpreted code. The speed increase is

(continued)

ARITY/PROLOG 4.0

I received some preliminary documentation for version 4.0 just before this article was to be published. Although I could not review the actual software, the documentation gives a glimpse of things to come.

The first change is a cleaner "cut" operation called a "snip." A snip looks like a list with cut symbols added, as in

```
[! snippet !]
```

where snippet can be any clause. The snip prevents backtracking through the snippet if it succeeds. This allows more control over the backtracking than a cut, which prevents backtracking to any prior point in a body. For example,

```
test :– a, [! b, c !], d.
test :– a, b, c, !, d.
```

The first allows backtracking on a if b and c succeed but d fails, whereas the second causes test to fail if d fails.

Version 4.0 also adds support for multiple "worlds." A world is a partition within the database (there is still only one). Separate "code" and "data" worlds are possible, with a current and default set being accessible at one time. The structure is not hierarchical nor automatic for any set larger than the current and default worlds.

Multiple worlds let you partition information for ease of use. It also increases efficiency, since the virtual-memory system works on world boundaries. Access to data within a particular world is faster because information in other worlds does not have to be examined.

Two other major additions are support for B-trees and hash tables. These are structures within the database and not file-oriented support modules. However, they do provide faster access to large amounts of information, even faster than using different worlds. Multiple-key support is described in the documentation but is not built in.

If all goes as planned, the new version of Arity/Prolog should be a powerful superset of the existing product. Sophisticated applications seem appropriate for this implementation, especially if you have a large hard disk and extended memory support.

AT A GLANCE

Name
Arity/Prolog 3.2

Company
Arity Corp.
358 Baker Ave.
Concord, MA 01742
(617) 371-2422

Computer
IBM PC, XT, AT, or compatible
PC-DOS/MS-DOS 2.0 or later
256K-byte minimum (640K bytes recommended)
One floppy-disk drive (hard disk recommended)

Compatible Software
Microsoft MASM assembler and linker
Lattice C

Documentation
The Programming Language
The Programming Environment

Price

Demo disk	$19.95
Interpreter	$350
Compiler/interpreter	$795

highly dependent upon the application. Computationally bound algorithms that do not allocate new objects might be up to 20 times faster, while other operations might be only two or three times faster. Disk operations might be only 10 to 20 percent faster.

Running the compiler is easy; it prompts for all information. Unfortunately, these parameters cannot be on the command line, which makes batch files less useful. The compiler generates object files compatible with the Microsoft linker normally supplied with MS-DOS. You can use compiled code with stand-alone programs. The code can also be included with the interpreter, in which case the compiled operators are available interactively.

You can also use assembly code and functions written in Lattice C in the same fashion as compiled code. C code can handle only those arguments that are integers, atoms, strings, and floating-point numbers. The documentation gives a number of examples and describes the interface mechanism in detail.

BENCHMARKS

I performed a few of the standard BYTE benchmarks, using an IBM PC XT with PC-DOS 2.1, 640K bytes of RAM, a 320K-byte floppy disk, a 20-megabyte hard disk, and no 8087 numeric coprocessor.

As you can see from table 3, the Write and Read benchmark operations are slightly faster than interpreted BASIC and change little between interpreted and compiled code, indicating the hardware limitation of the floppy disk. In general, screen-based I/O will speed up when compiled, but disk-based code will have limited speed benefits.

The floating-point calculation example is significantly slower than interpreted BASIC. However, BASIC is using a single-precision floating-point number, while Arity/Prolog uses double-precision. Arity/Prolog is slower for another reason: Unlike integers, floating-point numbers are allocated like strings. This uses additional overhead. Even so, floating-point operations are acceptable, and using an 8087 can speed up calculations.

The Loop benchmark (which tests the speed of an empty loop) and Append benchmark (which tests the speed of list manipulation) show the greatest change in elapsed time due to compilation. This marked improvement is more typical of AI-based applications where a good deal of unification is performed along with integer and list manipulation.

I did not do a benchmark for the Sieve of Eratosthenes prime-number program, because Arity/Prolog lacks arrays, which the Sieve algorithm uses. Using Prolog lists would significantly degrade the indexing operations in the algorithm. Modification of the algorithm to suit Prolog would make the algorithm very different from one written in BASIC or C. Comparisons would be difficult at best. Arity/Prolog works well with computation-based operations but not with arrays.

SUMMARY

Arity/Prolog is an excellent product. It provides a complete set of operators, including random file access and screen support. The virtual-memory facility can handle very large applications; it works well with a hard disk and is even better with a RAM disk. The new expanded memory boards should really make the system hum.

The only major items that need changing are the addition of a resident editor, removal of the copy protection, and better window support. However, Arity/Prolog provides a suitable environment for major AI work, especially on a PC AT with a large RAM disk and hard disk. ■

Table 3: *A comparison of performance times in seconds for interpreted and compiled versions of standard* BYTE *benchmark programs (writing, reading, and calculations) and two additional programs (loop and append), written in Arity/Prolog.*

Benchmark Name	Interpreted Time	Compiled Time
Write	31.5	29.9
Read	32.3	28.7
Calculate	362	153
Loop	15.5	0.9
Append	25.3	1.2

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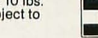


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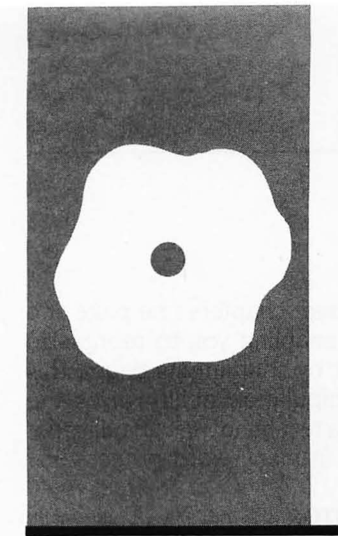
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Braille-Edit

Raised Dot's talking word processor

BY HENRY BRUGSCH

The revolution begun by the printing press and the linotype machine has created a barrier for the blind. The printed word is another reminder that we are unable to read or write without verification. The development of the typewriter brought us the capability of generating text, but we had to type and handle print without being able to read it or verify what we had typed. This meant that we had to be able to type flawlessly and accurately or that we had to have a proofreader on hand. In the last few years, with the advent of the microcomputer and breakthroughs in speech technology, a word processor for the visually impaired has become a reality.

Braille-Edit from Raised Dot Computing performs general word processing and translates printed material into braille and back (via a braille input device). You can write files in braille using dedicated keys on the computer keyboard, and you can move from Braille-Edit's file format to generating text files or other word-processing files.

To use the program, you need to install a speech synthesizer. Braille-Edit runs well with a variety of speech devices, including Intex Talker, Type-'N-Talk, and Street Electronics' Echo General Purpose Speech Synthesizer. But the most successful synthesizer for this program, the one on which it is based, is the Echo II (also from Street Electronics), now supplanted by the Echo+. This slot-mounted device requires 16K bytes of RAM (random-access read/write memory) to support its speech algorithms, which are built into the Braille-Edit program.

When you purchase Braille-Edit, you get a print-interface guide, either a print manual or a braille manual (your choice), or cassette versions of both. You also receive the double-sided disk-based software for the Apple II, Apple II+, and Apple IIc along with a year's subscription to *Raised Dot News Letter*. The Echo training disk is an option. Speech devices and attendant software are available from the appropriate manufacturers or directly from Raised Dot Computing. Braille-Edit is written in Applesoft BASIC and is licensed to run on Pronto-DOS, a variant of DOS 3.3.

Version 2.50 of Braille-Edit features these formats: print to braille, print to paperless braille (storing braille characters on magnetic tape), braille to print, Braille-Edit to text file, and text file to Braille-Edit. The program lets you copy unprotected disks and initialize blank ones. It also lets you construct files in the Bank Street format.

GETTING STARTED

You are first confronted with the double-sided disk and a fairly formidable manual. For a first-time user, the "boot before reading" approach is not recommended. The first time you run Braille-Edit, it asks you for a configuration. You can run one of four default configurations, which assume certain basic equipment conditions, or you can set up your own configuration (by hitting the asterisk key). To choose a default configuration, you key *2 for two-drive machines or *1 for one-drive machines. If you want speech synthesis, you key in *E followed by the number of drives on your machine to activate the on-board speech synthesizer. From the configuration prompt, *E enables you to enter your configuration through speech, following the appropriate prompts.

Once you have set up a configuration appropriate to your equipment, you are ready to use Braille-Edit. The program tells you the title of the menu you are using. In the first menu the words "STARTING MENU, ENTER COMMAND" are either displayed on the screen or spoken if you have a speech synthesizer. The starting menu lets you copy disks, initialize them, list their directories, etc. As the program is currently written, you get to the main menu by turning the disk over and pressing the space bar.

From the main menu you can execute basic editing operations or print docu-

(continued)

Henry Brugsch (32 Morgan Ave., Medford, MA 02155) is a professional piano tuner who recently became interested in computers. He has a B.A. from Tufts University. His other interests include amateur radio and steam-locomotive preservation.

AT A GLANCE

Name
Braille-Edit

Type
Talking word processor for the visually impaired

Company
Raised Dot Computing Inc.
408 South Baldwin St.
Madison, WI 53703
(608) 257-9595

Computer
Apple II, IIe, IIc, and compatibles

Documentation
Choice of print or braille manual and print-interface guide, or cassette versions of each

Price
$300
($275 prepaid)

ments; you can translate chapters (files) into grade 2 braille and back again (grade 2 applies to general generic braille); you can access a number of braille devices and interface to them; you can also load a file from another computer with a modem. You can initiate most Braille-Edit commands with a logical mnemonic. If you can't think of it, however, help is available. Either a return or a ? will give you a command reference to jog your memory.

From the main menu you can also access two other menus. Entering an S takes you to the secondary menu, which lets you process chapters. (The help functions are available here also.) From this menu you can manipulate chapters by changing their names or deleting, splitting, or merging material. Typing a Z at either the main menu or the secondary menu provides entry to the page menu, which lets you treat chapters one page at a time. By enabling you to reorganize a chapter by shuffling its pages, this page-manipulation ability gives the program a text-handling capability not available in many word processors.

THE EDITOR

Braille-Edit is a chapter- and page-oriented word processor. The editor creates a chapter from which you can create pages of text. A page can hold up to 4096 characters, the limit of allocated buffer memory. When one page is full, you can select and write the next page. You assign a chapter name and fill pages with your text. As you write and manipulate text, you can move pages about and alter their sizes. You can leave one chapter's environment and pull pages to another one. You can call in pages from other chapters and merge them with the

(continued)

original work. Only the size of your disk limits you.

Many of Braille-Edit's functions are chapter-oriented; others, however, are limited to page orientation. For example, the search feature can only be done one page at a time. If you wish to create a braille chapter, you run your completed text through the braille translator. You can also translate a braille chapter into print.

When you move from page 1 to page 2, Braille-Edit saves the text from page 1. Each time you change the page you're working on, the editor saves the previous page. This process is ongoing as you write and fill pages. Quitting the editor also saves your text.

The editor holds up to six screens of text in memory at a time. Control characters let you move about the document. The Apple IIe's arrow keys control up and down line movements as well as back and forward space movements. Control-F takes you forward to the next screen, while Control-B moves you back. If you are using the speech capabilities, there are five additional characters plus the arrow keys for working with screens.

Braille-Edit provides a global-replace function, available from the secondary menu; it lets you replace all occurrences of one given character or group of characters with another. This is done by means of a Braille-Edit chapter. You are limited to two pages of changes, or 8192 characters. The grade 2 translator is based on one of these transformation chapters.

Braille-Edit incorporates sound cues to help the blind user more readily access the features of the program. If you enter a control function in the editor, the program beeps to let you know when the function has finished execution. There are no sound cues for moving forward in text, but there is a quick buzz to tell you when the voice synthesizer has finished reciting the menu help screens. This is particularly useful during long chapter transcription runs. These buzzes can keep you informed of program status if you have silenced speech with a Control-X.

SCREEN FORMATTING

Braille-Edit formats screens by embedding special commands based on the dollar sign; for example, $P indicates a paragraph, $F initiates a form feed, $$H centers and underlines, and $L tells the program to issue a carriage return. So does Control-M, but for certain braille functions, this is not recommended. Tabs are based on real line spacing; they are not influenced by current margins. There are other $ commands that ma-

(continued)



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nipulate margins and page numbering, and you can enter these characters with a space on either side where appropriate in your text.

How do you *see* what you have typed? The main menu has a printer option where you can format the screen as you call the print routine. When the program asks for a specific printer option, you key an S to see your text on the screen in print format. The Echo II speech synthesizer can analyze a 40-column line while suppressing the dollar signs. This tells you if your formatting is correct and whether you have neglected to place spaces between the commands.

When you are satisfied with your screen presentation, you can print your text. Since Braille-Edit isn't configured for any particular type of printer, it makes some basic assumptions that might need changing. For instance, you may have to insert printer commands to obtain a desired type font.

PROBLEMS

As functional as Braille-Edit is, I found a few rough edges. The manual covers most contingencies very well. In section 26, the author explains what to do during an editor crash, which occurs far too frequently. In the event of a crash, you press Reset and then enter RUN 999. This saves whatever text is left in the editor in a chapter called Save. Then you go to the secondary menu, use the F option to "fix" the Save chapter, and create a new Braille-Edit chapter. Then you can append the new page to your article.

All this takes some time. On a few occasions, I found a lot of random rubbish (control characters and the like) that I had to manually strip from the text. One time my system crashed while formatting a list I was trying to create. When the editor died, the usual panic stations and alarm bells went off. I spent the next hour manually cleaning house. There was a lot of garbage, which proved a bit of a problem for the speech synthesizer. Indeed, until I got rid of the garbage, the editor crashed every time I loaded the tainted file. Obviously, the garbage in the file contributed to the program crash. (However, later versions of Braille-Edit seem to have fixed some of the problems with editor crashes.)

As it turns out, there is an easier solution. On the program disk is a transformation chapter called TXVB, which prepares text for formatting on a special braille device. It can also do double duty as a housecleaning aid. It strips all control and formatting characters from the text, and where double carriage returns exist, the program inserts a $P to make the paragraph acceptable to Versabraille, a cassette recorder from Telesensory Systems that delivers braille instead of music.

Another problem with Braille-Edit occurs with the command WRITE CHAPTER TO TEXTFILE. If you write an unformatted chapter to a text file without specifying a formatting command anywhere in the file, you get an unformatted text file with no carriage returns. As an early user of version 2.44a, which created a *formatted* text file whenever the WRITE CHAPTER TO TEXTFILE program was run, that's what I expected to find. The old version placed carriage returns at appropriate intervals (designated by the user) in the text. The transition to an unformatted text file in the later versions of Braille-Edit, 2.45 and up, was quite a jolt. After a number of phone calls to the author, I got the explanation that you have to insert certain formatting commands into the text to be converted. If you specify the width of a line by embedding a $W followed by the appropriate number, you will get a carriage return at the column width you specify. If, on the other hand, you wish to leave your carriage returns as you previously entered them, you will lose them unless you specify a line delimiter that tells the program to leave all existing carriage returns alone.

A FEATURE LOST

The older version of Braille-Edit, 2.44a, contained a program called Text Print that would display your text file on the screen. You could see whether the text file you created still ran true to form. This program doesn't exist in versions 2.45 and up; you must find your own means of reading your text files.

Another minor irritation is the search command. Since it is not a global search, you must comb several pages of text to locate a specific entry. This command is extremely effective, but its utility is lost to some degree by having to individually scan pages. Since each page has a finite limit of 4096 characters, that is the largest single amount of text that you can store in memory.

COMMENTS ON BRAILLE TRANSLATION

Although I cannot evaluate the braille output of the program at this time, I can summarize the braille features available. The configuration menu contains a number of profiles for different braille output options. Braille-Edit supports Versabraille. It also supports the Kranmer Brailler, an adaptation of the mechanical Perkins Braille Writer. The Kranmer Brailler was designed to be a stand-alone terminal and to interface with other machines. Braille-Edit also works with the braille embossers built by Triformations. Another braille output variant is the Dipner Dot system, which enables a standard letter-quality printer to produce braille. Braille-Edit can offer grade 2 braille output with any of these devices.

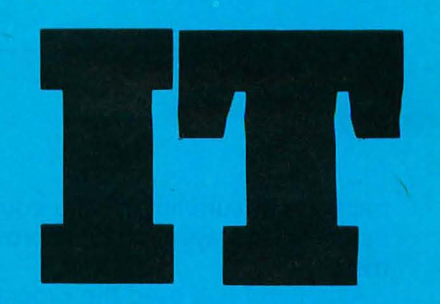
OVERALL IMPRESSIONS

I have been using Braille-Edit for the last nine months and have mixed feelings. It is a highly developed program with a great number of useful features, but it has a few failings and suffers from excessive construction. Since it now encompasses two sides of an Apple disk, Braille-Edit is somewhat cumbersome and involves frequent disk movements. It is not an easy program to use and has never been offered as such. With practice, you can get used to the numerous menus and disk accesses. As a diversified word processor and braille

(continued)

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translator, it currently has no equal, but there is always room for improvement.

Although I had used the program before getting the chance to review it, I requested a braille manual from Raised Dot Computing for this article. When the package arrived, it contained both braille and print manuals, as well as the cassette versions. The braille manual was on thick fanfold braille paper. Before I could read the manual, I had to remove all the tractor-feed edges and tear apart the pages. Since the manual contains 94 of these fanfold sheets, this was quite an undertaking. Would a commercial program for sighted users survive if you had to tear apart and organize your own manual? The disks arrived in two pieces of cardboard stapled together. The cassettes were wrapped in a piece of paper.

Version 2.50 of Braille-Edit experiences too many crashes. The time gained by the improvements in the editor are offset by the time lost recovering from editor crashes. In trying to deal with this problem, I approached several other Braille-Edit users to see what their experiences have been. One has experienced frequent crashes in the editor, while another has never had a problem. Phone calls to the people at Raised Dot Computing indicate that they know about the problem; they suggested I install a line-surge protector. I have done this and grounded all the equipment in the circuit. The crashes still occur.

Braille-Edit has been highly useful during the nine months I have had it. As improvements have come out and changes have been made, the features have multiplied. But as it has grown in complexity, it has also grown in size—from one side of a floppy disk and two menus to two sides of a floppy disk and four menus.

If you like, you can bypass Braille-Edit's menus. Once you are familiar with the program, you can move through the different functions by typing in the desired command. You won't see the menus until you enter a return or a ? at the prompt.

I have performed some timing tests on the program. You should realize that these tests were performed with Echo speech invoked. The times would be shorter without the audio clues. The scrolling function required between 10 and 12 seconds per page; the character count per page varied from 3077 to 3328. On top of this, each disk access requires 10 seconds, and each page requires one disk access. The search function was much quicker, needing only 1 second per page. However, you must add the constant of 10 seconds of disk access per page to this number as well.

SUMMARY

Braille-Edit has moved from a strong, reliable word processor in its earlier versions to a form that is taking some steps backward in version 2.50. The program has had to use more disk space and generate more disk accesses in order to preserve memory continuity. This means that as you proceed from the main menu to the secondary menu and then to the page menu with approximately 10 seconds for each disk access, you spend a fair amount of time waiting. This doesn't take into account the boot-up procedure.

Except for the editor crashes, Braille-Edit functions reliably. I haven't had any irretrievable situations, but sometimes it is frustratingly slow to get the program going again. However, at the time I write this, it is still the best talking word processor available (there are indications of other programs of this type to come). In fact, this article would have been impossible without Braille-Edit because I am visually impaired. ■

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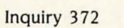
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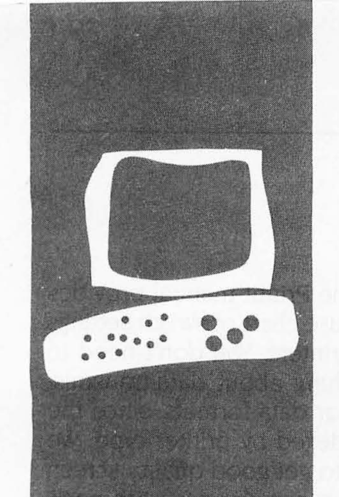
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Printit

A card that lets you print anything that's on an Apple II screen

BY HENRY BRUGSCH AND JOSEPH J. LAZZARO

Henry Brugsch attended Perkins School for the Blind and is a graduate of Tufts University. He is a self-employed piano technician and can be contacted at 32 Morgan Ave., Medford, MA 02155. Joseph J. Lazzaro is a freelance writer and consultant (Talking Computer Systems, POB 524, Revere, MA 02151, (617) 289-3828). He specializes in voice I/O systems.

How many times has protected software prevented you from printing text or graphics displayed on your Apple II's screen? Here is a printer interface card that lets you send text or graphics to your printer under any software circumstances.

Printit is a combination serial/parallel printer interface card made especially for Apple and Franklin computers. The purpose of Printit is to dump the contents of the screen to any standard serial or parallel printer, independent of whatever software you are running. This is significant since most software marketed today takes a heavy-handed approach: total domination of your computer. If a programmer decides that you should not have a printer routine in your new software package, then you are forced to live within those limits.

Printit changes all that. You can print anything on your screen automatically with a full set of print options: ordinary text, low-resolution graphics, high-resolution and double high-resolution graphics, 80- or 40-column text, side-by-side pages, inverse images, rotated images, double-size images, mixed graphics and text, black-and-white or color images, and emphasized print. With Printit's Control-I command, you can even send format commands to your printer. You can also use multiple options (for example, print a double-size black-on-white image). The combinations are many and useful. Printit is also not limited to just driving printers. The external device can be a plotter, another computer, or even a speech synthesizer.

Installing the Printit board is simple: Plug it into any Apple expansion slot and connect it to a printer with the supplied cables. (Be sure you get the right cables when you order your Printit.)

Push the activation button on the card and then hit a carriage return with any program in memory to get a full screen dump. Printit stops the software dead in its tracks. When the printing is finished, the program restarts where it left off, totally unaware that it was interrupted.

Suppose you have a graphics screen you would like to preserve and you can't initialize your printer card because the software is protected. Press the Printit button and a carriage return and you will get an immediate dump of your screen to your printer.

You can print anything that appears on your screen, even if it doesn't want you to. If you wish to change your printer's configuration during a program run, simply press the Printit button to halt the program. Then press Control-I (ASCII value 9). This tells Printit to send control codes to the printer. You can then reconfigure the printer with its own set of commands.

PRINTIT AND SPEECH SYNTHESIZERS

Printit can send nongraphic data to a speech device. This can be very useful to those people dependent on speech synthesis as their sole output medium. Printit works with the Votrax Personal Speech System, the Intex-Talker, or the Street Electronics Echo General Purpose speech synthesizers. The Votrax and Intex-Talker are both serial/parallel synthesizers; they will work with Printit configured either as a serial or a parallel device. With an Echo GP, you can use only the serial configuration.

Think of Printit used in this way as a brute-force speech dump. It is not a user-friendly way for a blind computer user to access his or her software, but if you cannot get a software package to "talk" by any other means, Printit is one solution.

A STANDARD INTERFACE CARD

Printit functions just like an ordinary serial or parallel printer interface card. You do not need to press Printit's button to make your printer print. Printit can be driven in the normal way by most software packages. For example, if your Printit is in slot one and you want to set up your printer for 80-column

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print, do the following: push Printit's button, press Control-I, then type 80N. You can even issue these commands from within a BASIC program:

```
10 PRINT CHR$(4)"PR#1"
20 PRINT CHR$(9)"80N"
30 END
```

As far as a word processor is concerned, it is talking to a standard Apple parallel interface card. All text formatting is accomplished in the normal manner, and all printer control setup codes are the same.

COMPATIBILITY

Printit is totally Apple-compatible. It runs on any Apple II computer (except for the IIc) and Franklin Apple II clones. The Franklin 80-column card, which resembles the Videx, will not work with Printit in certain configurations.

If you have a Microsoft CP/M coprocessor card in your system, you may encounter problems. When you press Printit's button, it may not be able to halt the coprocessor card.

PRINTIT WITH PRINTERS

We tested Printit on the Star Micronics Gemini-10X and the Okidata MU-92 printers. The Printit manual provides an easy-to-use chart of switch settings for most printers. You don't need to know anything about data-transmission rates or data formats, since the chart is indexed by printer type. We were able to get good-quality screen dumps from popular software packages at the press of a button.

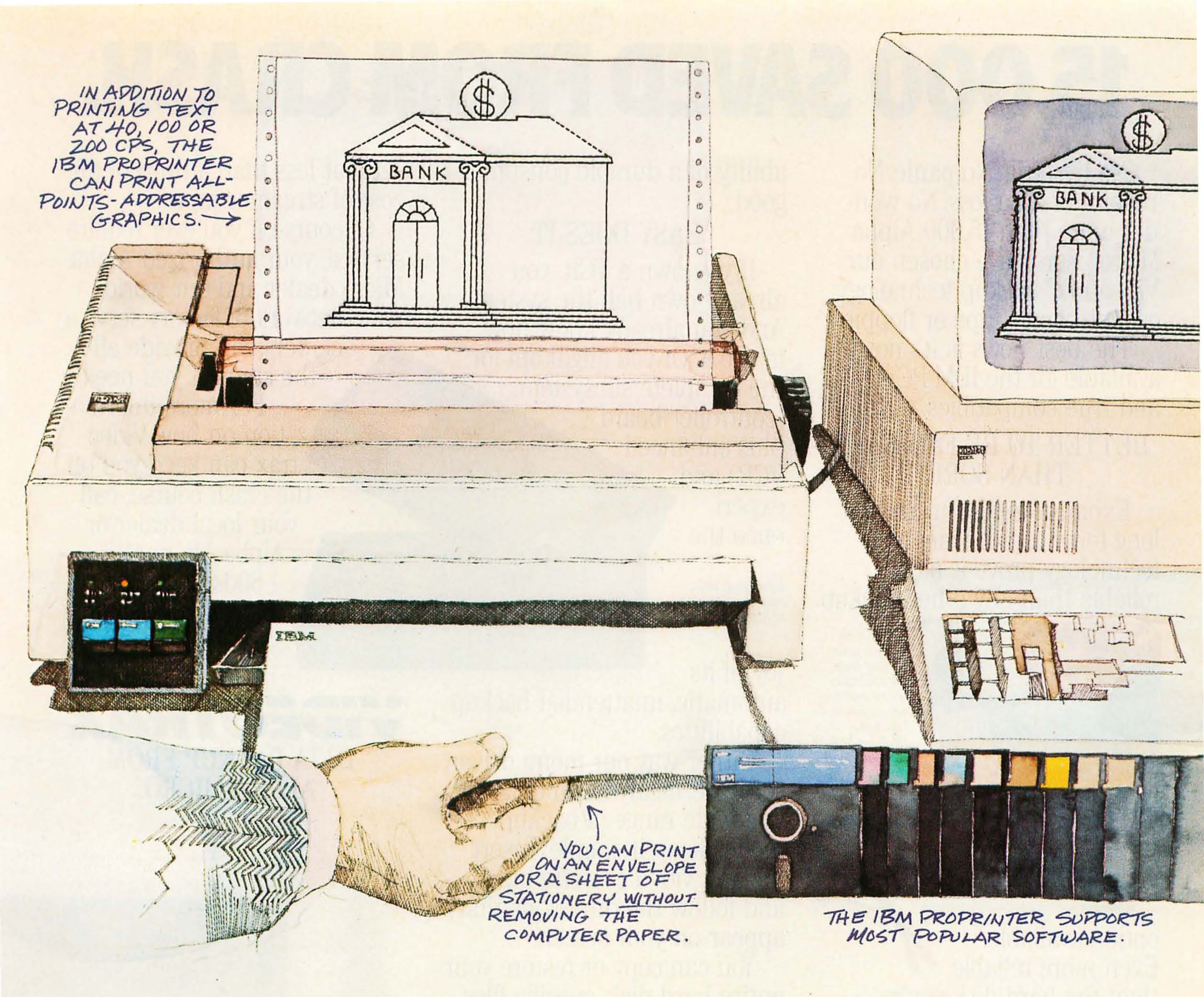
We were also able to double the size of the image by pressing Printit's button, typing D, and hitting a carriage return. You can print a double-size emphasized version of the screen by entering ED and a carriage return. It is easy to mix multiple command options; you can even get an emphasized, doubled, inverted, white-on-black image. See table 1 for a complete list of printer options.

CONCLUSION

Printit is worth its price, especially when you consider that this board has built-in serial and parallel compatibility. Its one drawback is its inability to handle two-way telecommunications traffic, like the Apple Super Serial Card. If you need a flexible printer interface card with the power to punch through protected software, give this board a close look. ■

Table 1: *Printit's commands and their functions. Commands can be passed to Printit either through software or the keyboard after you press Printit's button.*

Command	Function
1	Display page #1
2	Display page #2
4	40-column print
8	80-column print
P	Print graphics only
M	Print mixed graphics and text
V	Double high-resolution or low-resolution graphics
C	Normal high-resolution or low-resolution graphics
S	Print pages #1 and #2 side by side
D	Print double-size image
R	Rotate image 90 degrees
I	Print inverse image (white on black)
W	Print black and white
L	Left-justify image
E	Print emphasized image
Control/I	Send commands to external device



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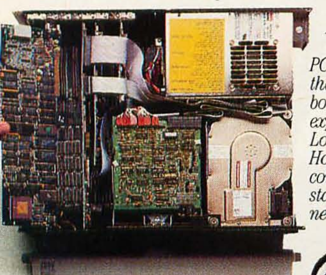
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ENABLE

I have been an Enable user for ten months. The following is my review of your review of Enable (January, page 331).

Steve King concluded the review with the statement "Although I've heard version 1.1 is better, I found Enable 1.0 not quite ready and able. . ." It seems unprofessional to publish a review of a product that is not the current version. The review mentioned but a fraction of Enable's features. One of these was so misunderstood by both Rich Malloy and King that it was singled out as a major drawback, namely the fact that Enable's menu and command sequences were dissimilar and therefore (so you thought) confusing.

On the contrary, this is in fact an asset, once you understand that the menu selection is for those who prefer to use the arrow keys to move the block cursor and/or type single initials to match the displayed choices of the menu. In this case your review was a disservice to both prospective Enable buyers and to the Software Group, producers of Enable. The update 1.1 version was first shipped three months before the January date of BYTE.

I realize the publishing predicament of soliciting a review then finding it is out of date at the time of publication. The only fair course in this case is a new in-depth review of Enable 1.1, rather than trying to redeem the time-expired review with a hasty half-page text box about the new version.

REV. FRANCIS G. MCCLOSKEY
Albany, NY

Steve King's review of Enable was right on target, making it obvious that he has used the program.

King is absolutely right that version 1.0 was unusable. My version of 1.1, with some October 1985 changes, is a vast improvement. (I mention the date of my latest changes because they are continuing to make minor changes. An earlier release of 1.1 is clearly different.)

Some may wonder what Enable is good for. Enable is the only integrated program I've seen with adequate help screens and prompts. No keyboard overlay is necessary, and the commands, if sometimes awkward, are at least usually consistent.

I have found Enable to be well suited to odd multifunction jobs, especially where there are involved computations to be done in a relational database (exponentials and trigonometric functions, etc.), and the results are to be included in a mail-merge letter. Billing for leased equipment where there is a variable interest rate is a good example of its capabilities. If the new release has as many improvements as were made in version 1.1, it should be a winner.

CARTER HARISON
Beaverton, OR

AT&T PC 6300

I am writing in response to Bob Troiano's review of the AT&T PC 6300 (December 1985, page 294). I am very familiar with the IBM PC XT and I think the AT&T is by far the better of the two, especially if you use Lotus 1-2-3!

PC 6300 readers should take note of the suggestion for adding 512K bytes of memory to the motherboard. This will save the PC 6300 owner a lot of money. I paid an estimated $550 less than if I ordered from AT&T, and $450 less than if I acquired AST's SixPakPlus with 384K bytes of memory, a memory-expansion board, and a 128K-byte expansion kit. I had already installed the 256K memory chips, but I could not get anyone to give me the appropriate DIP switch settings. Mr. Troiano's article gave me most of the information I needed.

One caution about the setting of DIP switch 1 (aka bank 1): The switch should not be adjusted unless the PC 6300 user wishes to reconfigure the unit's disk drives. For example, the setting that Mr. Troiano recommends configures the system with a floppy-disk drive and a hard-disk drive designated as drive C. Settings are different if you have two floppy drives or if you designate the hard disk as drive C, as shown below:

Troiano recommendation: 00110011
Two floppies: 00000110
One floppy and the hard disk designated as C: 00110100

In addition, I'd like to offer advice to potential PC 6300 buyers: Many dealers sell the PC 6300 equipped with 128K or 256K bytes at very similar prices. If you select a unit with 256K, you will be forced to purchase a memory-expansion board as well as chip sets to increase the PC's memory to 640K. I recommend that potential buyers order the 128K unit, install eighteen 256K chips, and set switch 0 as recommended.

As far as software is concerned, AT&T has released an update disk for MS-DOS 2.11 and GW-BASIC. This disk includes some new programs.

MICHAEL J. SOBOTA
Schaumburg, IL

I purchased an AT&T PC 6300 in August 1985 and really do like it; however, it has also caused hours of frustration.

I agree with Bob Troiano's comments on the machine's speed, operability, and compatibility. I have upgraded to 640K bytes of memory and have added virtual-disk capability with 360K bytes. Uploading my operating software to drive C really makes the machine faster than any I've seen. I imported the virtual-disk operating software from PC-DOS 3.0, as the AT&T user's manuals do not discuss virtual disks. All common IBM software runs fine on my machine. As the review pointed out, however, the GW-BASIC provided with the unit does not directly interface to BASICA. As a matter of fact, I have several programs waiting for patches to get them running.

On the other hand, I don't agree with Troiano's speculation on AT&T's product support. I have had my machine in the shop three times for a total of over seven weeks. It has gone through three power supplies, two disk drives, two keyboards, and three motherboards. The longest delays I experienced were because motherboards were out of stock. If indeed motherboards are scarce, I would caution potential customers against buying the machine until the problem is corrected.

AL SARGEANT
San Diego, CA ■

REVIEW FEEDBACK *is a column of readers' letters. We welcome responses that support or challenge* BYTE *reviews. Send letters to Review Feedback,* BYTE *Publications,* POB 372, *Hancock,* NH 03449. *Name and address must be on all letters.*



Kernel

ONE COMMON THREAD that seems to weave itself through many of Jerry's columns is his attendance at parties. We all realize that this is a nasty job, but Jerry knows full well that somebody has to do it. This month's column finds him hosting a BIX party at Chaos Manor. Fortunately, he is able to survive the party and forge ahead. Much of the column deals with a wide variety of software. One of the products that he is quite impressed with is an integrated package known as Q&A.

BYTE presents a new column this month—Applications Only, written by Ezra Shapiro. The column is intended to provide a quick look at various applications software packages. This time, Ezra reviews four new products—Turbo Editor Toolbox, Ready!, Balance of Power, and Easy.

The Macintosh from Apple, the Atari 520ST, and Commodore's Amiga are the three prominent 68000 machines that are causing a stir in microcomputer circles. Now having all three of these computers, Bruce Webster begins his comparison of them in this month's According to Webster. He takes a number of different areas and ranks the machines in each of them. Bruce's observations show him that each machine has both strengths and weaknesses and that there is no clear winner.

In BYTE Japan, Bill Raike looks at a new language called Mind, which he believes is the first programming language created in Japan. All of Mind's reserved words are written in Japanese kanji characters, and the statement syntax resembles that of the Japanese language. Bill also describes his new laptop—the Fujitsu FM-16π.

The Amstrad PCW 8256 is a Z80-based computer and word processor from Amsoft of Essex, England. At £399, it is actually a dedicated word-processing system for less than the price of many electric typewriters. So far, these new Amstrads have been popular in their homeland, and Dick speculates that they may soon be available in the U.S.

The subject covered by Bob Kurosaka in Mathematical Recreations is the Diophantine equation. A number of methods are available for solving this type of equation, but this month's column looks for a method of solution based on general principles of mathematics. There is also a section on mail received from readers of previous columns.

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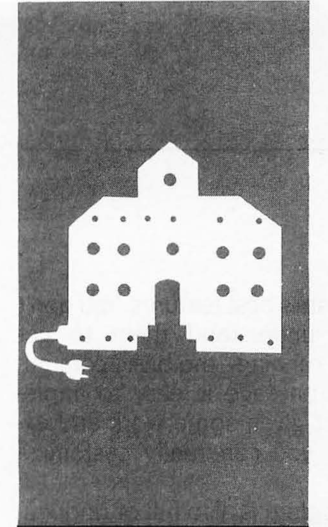
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COMPUTING AT CHAOS MANOR

All Sorts of Software

BY JERRY POURNELLE

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

Well, we survived the big party. About half the civilized world, and a third of the barbarians, seem to have wandered through Chaos Manor at one time or another during the evening. My neighbor's yard was so littered with champagne corks the next morning that I had to send the boys out with trash bags. Half a dozen Black Forest and San Honore cakes, a gallon of Athol Broz, three gallons of chili, and 12 feet of stevedore sandwich disappeared without a trace. We had two separate computer systems connected to BIX (BYTE Information Exchange) so that those on the network could share in the festivities. And a good time was had by all. Mrs. Pournelle, who thinks computers are boring and computer parties more so, had fled to San Jose for the evening and returned with some trepidation; but amazingly nothing was broken. In fact, thanks to honorary hostesses Pamela Clark and Barbara Clifford, things were in such good shape that the housekeeper gave no more than a token look of disapproval.

COMMUNICATING

One of the people I met at my party was Connie Kageyama. It happened this way: when we got Philippe Kahn of Borland International on BIX, he was somewhat unhappy with the speed of the mail system. (It was pretty slow, but that's been fixed.)

"It takes too long. You're on line too much," Philippe said.

"True, but what can I do?"

"Talk to Connie Kageyama," said Philippe, which turned out to be good advice. Connie is a system operator for CompuServe's IBM Special Interest Group and calls himself a computer hobbyist; but he knows more about computer communications than most professionals I've met. He says he isn't creative, which may be, but he's one heck of a problem solver. After a couple of weeks playing with BIX, he had some suggestions, including some programs he wanted to bring over; it seemed natural enough to invite him to the party.

The result is a series of command scripts for the Crosstalk communications program. I can use these to log on to BIX, get my mail and the conference materials I want to read, and log off the system. All this happens while I go for coffee. Then I can read the stuff at my leisure.

I also have a program furnished by one of the Bixen—inhabitants of the BIX network—that is said to parse headers and sort the conference messages. I confess I haven't used it yet because I'm told an improved version is in the works. What I really need, though, is a program that will do even more: sort through the messages, assigning some to a priority file and others to the bit bucket depending on subject matter and origin; then let me, still off line, answer the messages using a good full-screen editor with a spelling checker; then go back on line and squirt the answers into the various conferences in which they belong.

I don't have such a program, but I'm working on it. "Working on it" doesn't mean I'm going to write it, because I have neither the time nor the expertise to do it. What I have done is tell every computer genius I know that a real integrated communications package making use of current artificial intelligence concepts is likely to make a lot of money. It seems a natural: more and more people are involved in computer communications whether they like it or not, and most of them are going nuts.

BURNOUT?

There's a lot of literature on computer conferencing. Most experts in the field describe a pattern: a new user discovers computer-mediated conferencing; it's wonderful—the best thing that's happened in years; the user becomes addicted. Then the trouble starts.

A recent letter described the problem exactly: whereas an open computer conference begins with a small number of well-informed and highly interested participants,

(continued)

it soon attracts others. That's all right; it's supposed to attract others. Where else would you get new ideas? But soon it attracts too many, far too many, and some of them are not only uninformed but aggressively *mis*informed. Dilution takes place. Arguments replace discussions. Tempers are frayed.

The result is that while computer conferencing began by saving time, it starts to eat up all the time it saved and more. Communications come from dozens of sources. Much of it is redundant. Some of it is stupid. The user spends more and more time dealing with irrelevancies. One day, the user wakes up, decides the initial euphoria was spurious, and logs off, never to return. This is known as burnout, and it's apparently quite common.

Certainly something like that happened to me; but as it happened I noticed something: most of the irritation came from a handful of people, sometimes only one or two. If I could only ignore them, the computer conferences were still valuable. Alas, it's not always easy to do; temperament and emotion work against overlooking some of the dreadful things people say, while good manners (and in my case, residual memories of being a teacher) dictate that you pay some attention to the sincere but confused. Easy or not, you must restrict your interactions, especially on a system with thousands of users, or burnout is inevitable. I can't do that alone, but the next generation of communications software should help me accomplish it. I can hardly wait.

CROSSTALK

In addition to the scripts, Connie Kageyama brought over a copy of the latest revision of Crosstalk. Crosstalk scripts—command files—are one of the program's best features. You don't need to understand them to get Crosstalk running—the basic communications package is easy to implement—but given some work and experience, you can really customize Crosstalk.

The program is also full of undocumented, or poorly documented, features. For example, I installed the new Crosstalk by copying it into the XTALK subdirectory of the Kaypro 286i's hard disk, then invoking it. All my old scripts and communications files worked fine—as they were supposed to—except that now, instead of white letters on a black screen, I had green letters.

I don't much like green on black. The newest version of Crosstalk has needed features, such as the Kermit system for sending long files, so I didn't want to go back to the old one; but I also didn't want those green letters. Surely there's a way to change back to white on black, I thought.

Clearly it was time to open the manual. First things first. Start with the index and look up "color." No. Try "screen." No index entry for that either, and none for any other word I thought relevant. Eventually I gave up on the index.

Next step: the old version didn't change screen colors. This is a new revision. Look at the pages specific to this revision. Aha! A new command, VIdeo (all Crosstalk commands can be invoked by their first two letters). Surely that will do it—but of course it didn't. I tried other approaches, but eventually I gave up and called Microstuf, Crosstalk's publisher. After a couple of minutes, I was connected with Bob Strong, who with Les Fried founded Microstuf back in the hobbyist 1970s.

I'm glad I called. Strong is one of Crosstalk's designers, and he knew all about its undocumented features. "There are two ways to change the screen color," he said. "You can patch the EEKS file [that's how he pronounced it; I presume that means the EXE file, although I never got around to asking]—there's one byte for the

(continued)

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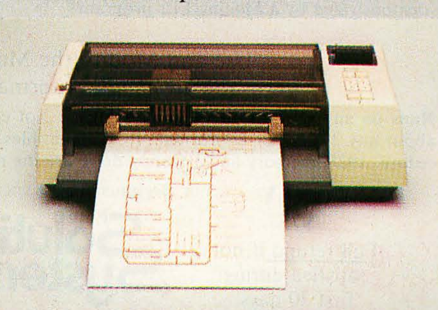
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With Crosstalk you can change background and highlight colors.

highlight color and another for the normal letters—or you can use the SCreen command."

"SCreen command?" I asked blankly.

"If you have Crosstalk up, enter SCreen HElp."

I did, and up came information on changing the screen colors. For a moment I felt sheepish, then I remembered I had looked for SCreen in both the index and the command summary and found nothing.

As it happens, if you just enter HElp, Crosstalk gives you a list of possible commands. Sure enough, buried in the middle of a 7 by 12 array, not sorted in any order whatever, is the word SCreen. All I had to do was read each of those 84 commands. For that matter, I find that on the third page of the table of contents, the seventeenth entry for Chapter 6 (Terminal Features) is "Changing the Screen Colors."

Indeed you can, given close reading of the manual, change both background and highlight colors; you can make the letters pale blue on a bright blue screen with yellow highlighting (rather pleasing, actually; just enter SC N Cb) or almost anything else. You can put screen colors into your various communications files so that, for example, you can use one set of colors for BIX, another for Dow Jones Information Retrieval, and yet another for communicating with your friendly neighborhood hobbyist bulletin board and have those colors come up automatically. Of course, you'll first have to find the proper commands.

Even then you want to be careful. The example they give of using the SCreen command is "SCREEN A FB, where A specifies the type of characters you want to set (N for normal, H for highlighted, or L for status line),

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The Printer Optimizer stores text and doles it out to the printer as needed; meanwhile, you can use the computer for something else.

F sets the foreground color, and B the background color." Sounds clear enough, but if you do that, you will get a blinking background that drives you mad. It turns out that you must use a *lowercase* letter to specify the background, else it blinks. The manual never tells you that. I suspect that the only reason they don't get more frantic phone calls is that so few people find the instructions to change the screen colors in the first place.

Incidentally, it turns out that you can *change the color* of the status line, meaning that you can, if you like, blank it out entirely by putting black letters on a black background. Of course, if you do that, you'd better remember how to get it back again, or you'll have to give all your commands by memory.

I do like Crosstalk. I can't claim to be an expert on communications programs, but I have used several of them, and I now use Crosstalk for all my conferencing and telecommunications, meaning that I prefer it to anything else I've tried. I also like Microstuf's upgrade policy: if you have bought the program in the last year or so, the upgrade is free, and if you have an ancient copy that requires a new manual, the cost is still nominal.

I like Crosstalk, but that manual has real problems. Of course, it is a dilemma. The Microstuf people don't want to overwhelm you with hundreds of pages that you must read before you can use the program; on the other hand, they keep adding features.

For example, there's a DEbug command. With DEbug you can set the way incoming control characters are treated: let them come through unaltered and display them as hexadecimal numbers so that an incoming Control-Z is shown on your screen as [1A], display as ASCII mnemonics so that the Control-Z is shown as [SUB], or show the Control-Z as ^Z. The really nifty feature of DEbug, though, is the RS232 command: when you invoke it, you see precisely what's happening with pins 2, 3, 4, 5, 6, 7, 8, and 20 of your serial communications line. Bob Strong says he added that feature because he got tired of having the batteries burn out in his breakout box.

There are tons of other features, some well-documented, some pretty obscure. Documenting them all in great detail would scare off users; not documenting them drives us nuts. What to do? The problem is hardly unique, and there is a solution. Read on.

PRINTER OPTIMIZER

By coincidence, I'd just finished talking to Bob Strong at Microstuf when I decided to hook up my new Printer Optimizer from Applied Creative Technology (ACT). The Printer Optimizer is a smart box with lots of memory. It sits between the computer and the printer, and the computer talks to it at 9600 baud. The Optimizer stores the text and doles it out to the printer as needed; meanwhile, you can use the computer for something else.

That's worth something, but actually the Optimizer does a lot more. It's programmable, so you can take text formatted for one printer and translate it into the format for another one. You can store a huge bunch of text in the Optimizer and print it later. You can stop printing, bring in more text, print that, and go back to the original job. You can use the Optimizer to dial up special features for your laser printer. You can even use the Optimizer as an adapter to let your Macintosh drive a non-Apple laser printer.

Finally, the Optimizer is pretty smart: you can have two computers and two printers hooked up to it and use it as a switching device so that either computer can drive either printer. In my case I have Zeke II, the CompuPro Z80 I write with, and Big Kat, the Kaypro 286i AT-compatible, both connected to the Optimizer. Works like a charm.

I've had an Optimizer for a couple of years now. Last summer, just before we went to Europe, Tim Wylde, founder of ACT, was here in California and came over for a visit. He discovered just how ancient my Optimizer was and sent an upgrade.

The main feature of the new Optimizer is that it takes up to a full megabyte of memory. The 64K-byte boards from the old one also work, either by themselves or in combination with the newer 256K-byte boards. My Optimizer has one 256K-byte and three 64K-byte boards, for a total of 448K bytes, which is as much as I'm likely to need. (Well, *Footfall* was almost a megabyte long, but that was an unusual case.)

The Optimizer comes with lots of documents. It has to, since it's designed to work with a variety of computers and printers. Unlike Crosstalk's documents, these make no attempt to conceal the machine's features: just the opposite. Begin reading, and you're soon plunged into the mysteries of character substitution, how an RS-232C port works, and like that. It's all written in plain language and is very useful.

However, I didn't need an introduction to the RS-232C port. I didn't even need the discourse on switch and cable settings because all I had to do was copy the switch setting from the old Optimizer into the new one. Indeed, when I compared the two, I found that the new switch had already been set up like the old one. Good, I thought. One less thing to worry about. Just plug in the cables and send over a test file—which I did.

The Optimizer displays the amount of free memory; as text is pumped into it, the number on its screen decrements. Sure enough, 448 went down to 447, then 446, at which point

(continued)

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Zeke indicated that as far as he was concerned, the file was all printed. The printer, however, remained silent. (Laser printers take about 25 seconds for the first page, then print about eight pages a minute.) I waited—

Still nothing. Clearly the Optimizer wasn't giving instructions to the printer. Back to the manual. Aha! Here's a hands-on tutorial for getting started—only it tells me how to do command substitutions. Nothing about making the thing print. Try another page. And another. Hmm. Here's an interesting note. "If any problem takes you more than 10 minutes, call Applied Creative Technology." Right.

I called. It turns out that the Optimizer by default wants to send the text out through its parallel port, which is port 1. To change to the serial port, you press the P, the 2, and the Exe buttons on the Optimizer's little control pad. It took the ACT people about 10 seconds to tell me that, and once it was done, printing began immediately. Nothing to it—except that I couldn't find that instruction, although I'm sure it's buried somewhere in the manual. Everything else is.

"Be sure to tell them we're revising the manuals. Also that we're *real* helpful on the phone," said the ACT people; and indeed it's *all* true. More than that: the Optimizer's documents have some of the best material on the mysteries of the RS-232C port that *I* have seen. The Optimizer includes a little built-in breakout board, and the appendixes on how to use it to hook the Optimizer to different printers are outstanding for their simplicity *and* clarity. They explain complicated stuff very well; it's the obvious they've overlooked. It's not an unusual situation.

I have a remedy. Both the Printer Optimizer and Crosstalk documents need examples. Here's what you do, and here's the result. Put in a dozen or so of those, and most users will be able to figure out what's going on. Moreover, documents should start with the simplest possible applications. I've always recommended that every computer language document should begin with that language's equivalent of PROGRAM 'Hello', which does nothing but print "Hello" on the screen. Similarly, every hardware and software document should have a section showing precisely how you go about getting the most elementary feature to work.

Pournelle's law of documentation: "You can't have too many examples."

OUT OF MEMORY

It was inevitable. It began with SideKick, the indispensable—to me at any rate—memory-resident utility from Borland International. Then

(continued)

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The Turbo Lightning memory-resident on-line thesaurus is a wonderful tool for editing text. It beeps at you if you misspell a word.

came Borland's SuperKey macro program, which isn't quite as indispensable as SideKick but darned useful. I use SuperKey to define a whole bunch of convenient BIX commands; for example, Alt-down-arrow is Skip to last, which in BIX jumps to the last message in a conference, while Alt-F9 does a long and complicated routine of some 20 keystrokes to prepare previously edited text to be sent out on BIX. I could live without those, but I wouldn't want to.

Then came Borland's Turbo Lightning memory-resident on-line thesaurus. It's a wonderful tool for editing text. Lightning beeps at you if you misspell a word while writing. This is sufficiently annoying that I generally turn off that feature until I have the draft composed; then it's simple and convenient to switch Lightning back on and have it check the spelling; and meanwhile the thesaurus has been instantly ready for use at all times. I guarantee that writers who get used to an on-line thesaurus won't give it up lightly.

For that matter, the continuous spelling checker with its beep can be useful when writing letters, composing quick answers to questions in an on-line conference, or anytime you're in a hurry and aren't trying to be creative. It's something else you can get pretty accustomed to having around.

SideKick, Lightning, and SuperKey among them use up a lot of memory, but they do work together.

The trouble started with Gordon Eubanks. Gordon is a former Navy submarine driver. He's been in the microcomputer revolution since the beginning. He wrote the first compiled BASIC—public-domain E-BASIC—while a professor at the U.S. Navy Postgraduate School in Monterey, California. After retiring from the Navy, he turned E-BASIC into CBASIC, which, despite my enthusiasm for Modula-2, is still the language I've used for all my large and important programs. Eventually, Gordon's company was sold to Digital Research, and Gordon became Digital Research's vice president in charge of languages. About a year ago, he left to run a new outfit known as Symantec.

Symantec is seriously trying to apply artifical intelligence (AI) principles to business programs. The first result is an integrated package known as Q&A (see the Product Preview in the January BYTE, page 120), and just before my monster party, Gordon wanted to come down and show it to me.

I don't usually let software publishers find out what city Chaos Manor is located in, much less invite them to my house. But Gordon isn't a publisher, he's a hacker from the early days, and Lord knows back in those days I bent his ear enough about problems I'd found and features I wanted in CBASIC. So the day before the big party, Gordon Eubanks showed up with a colleague, Brett Walter.

Walter's business card gave his title as Product Marketing Director, which was a bit frightening. In fact, Brett turns out to be a hacker and former philosophy student, and it didn't take long before we began talking about some of the AI theory in Q&A, including intercensal references. Somewhere in the conversation—I can't believe I said it—came the word "disambiguation." This caused Eubanks to say, "Jeez, we work for years to make this thing user-friendly, and all these Ph.D.s want to complicate things. You're not going to talk about that, are you?"

Meanwhile, Gordon and Brett were

(continued)

The Q&A editor is very similar to WRITE, the CP/M text editor that I use for all my creative work.

working to install Q&A on Big Kat; only it wouldn't install. There wasn't enough memory.

THE Q&A EDITOR

Eventually we solved the problem by killing off Turbo Lightning. Q&A says it works with both SideKick and SuperKey installed, provided that you've completely filled the machine with memory. I used to have SideKick, SuperKey, and Lightning all come up when I turned on my machine, and now I can't do that if I want to use Q&A. The temporary solution is batch files: I rename my AUTOEXEC.BAT file to HOLD.BAT and rename QA.BAT to AUTOEXEC.BAT. Then I reset the machine, and it comes up in Q&A with SideKick and SuperKey installed. On exiting Q&A, I invoke yet another batch file, RESTORE.BAT, which puts everything back the way it was so that on reset I'm in my normal mode. That works, but it's hardly convenient.

On the other hand, Q&A has such a nice text editor that I'd seriously consider using it as my primary writing tool. It does have its problems, including the inevitable status line at the bottom with the little blob moving along it every time I type a letter. The Q&A editor is very similar to WRITE, the CP/M text editor I use for all my creative work. (Confusingly, Symantec calls its editor Write also; I don't see how they can get away with that, since WRITE was trademarked by Tony Pietsch, but I'm not a lawyer. Anyway, to avoid confusion here, when I refer to WRITE, I'm speaking of Tony's editor that works on CP/M systems.) The Q&A editor does automatic on-screen reformatting on both insertion and deletion. It moves text around nicely. It's fast and clean and handles the screen layout well. The command structure is reasonable and logical, and there's a nicely laid-out one-screen summary of commands available at the touch of the F1 key.

There's a macro capability and scrolling by screen or document page or continuously (on the Kaypro 286i it scrolls fast, as fast as my Z80 memory-mapped video). There are commands to delete lines, characters, and words. It doesn't count words automatically, but there's a way to get a word count. (That takes seven keystrokes. WRITE automatically gives you a word count, and with two keystrokes you can get a count of words, lines, and paragraphs for text before and after the cursor—a real boon for columnists. I've mentioned that to the Symantec people, and they're looking into it.)

I could go on for a while, but the bottom line is, it isn't WRITE. However, if Symantec would only let me turn off that damned bouncing ball at the bottom of the screen, I'd seriously consider writing books with the Q&A editor—especially if I could figure out some way to use both it and the Turbo Lightning thesaurus. I keep hoping Symantec will be able to work something out.

INTELLIGENT ASSISTANT

Of course, Q&A is more than a text editor. It integrates your text editor, file manager, database, and report generator. Now let me confess immediately that I am no expert on databases and file managers. I don't even use the darned things much. I should, of course. There are lots of ways a good computerized database could help run my life. For a start, I could get all my royalty statements entered and thus keep track of which publishers have paid and which are overdue, which books have foreign editions, what printing each book is in, and a whole raft of stuff that I now painfully dig out of paper records.

The reason I haven't done it is that each time I need the information it's easier to dig out by hand than to put it all in a database; and so far I haven't seen a database and file manager that I could use to design my entry fields, then hand the whole mess over to an assistant to fill in the data. Not only are most databases hard to learn, but sure as anything, my form design is going to lack something. For example, suppose I put in fields for nearly everything, but when we're entering the data, we discover that *The Mote in God's Eye* has been translated into Finnish, and I haven't included a Finnish rights category. Where do we enter that revenue? Miscellaneous might be an obvious answer in this case, but then we discover Malay translation rights, and after a while the miscellaneous category gets filled with *all* kinds of stuff.

Q&A solves that problem. You can add new fields at any time. You can also rearrange them. The data-entry fields are designed with the Q&A text editor and can be as complex as you like: keyword fields, numerical data, Boolean data types, labels, you name it and Q&A seems able to handle it. Simple to learn, easy to use.

All well and good, but that's not what makes Q&A different from other database programs. The real reason I'd like to adopt Q&A is the Intelligent Assistant, an AI program that takes plain English instructions and uses them to control the Q&A database. Intelligent Assistant—IA, and I suspect the similarity to AI is no coincidence—can make up quick-and-dirty reports, find information, sort information, do calculations, answer questions about the database, and, while it's at it, learn a lot about how you operate. It has a synonym dictionary, so if you don't like the built-in commands Q&A uses, you can substitute your own.

For example, IA can do things like "Find me all the books that have revenue from Danish and Finnish rights." It needs to know that "Finnish rights" is the same as "Finnish translation rights," but that turns out to be a simple thing to teach it. Indeed, you begin by giving the Intelligent Assis-

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tant lessons: what the database is all about; what fields identify a form (what most databases call a record); adjective forms of nouns; units of measure; alternate field names; strange verb forms (associate "paid" as well as "pay" with a particular field); adjectives ("lousy" means royalties of less than 8 percent); stuff like that. Interestingly, IA already knew that "royalties" was the plural of "royalty," so I didn't have to teach it that. There's lots more, mostly good. Some isn't so good.

PROBLEMS

I like Q&A, and I think it has great potential; but I think Symantec still has some work to do. Some problems are cosmetic: I want them to kill that bouncing ball in the text editor, and nearly as important, let me change the cursor from a blinking underline to a transparent solid blob. And I would like to change screen colors. I've become enamored of light blue on darker blue, and I don't see why I can't tell the text editor to do that; it only involves a couple of bytes of code. Just tell me the screen-attribute locations, and I'll be glad to write a BASIC program to patch it.

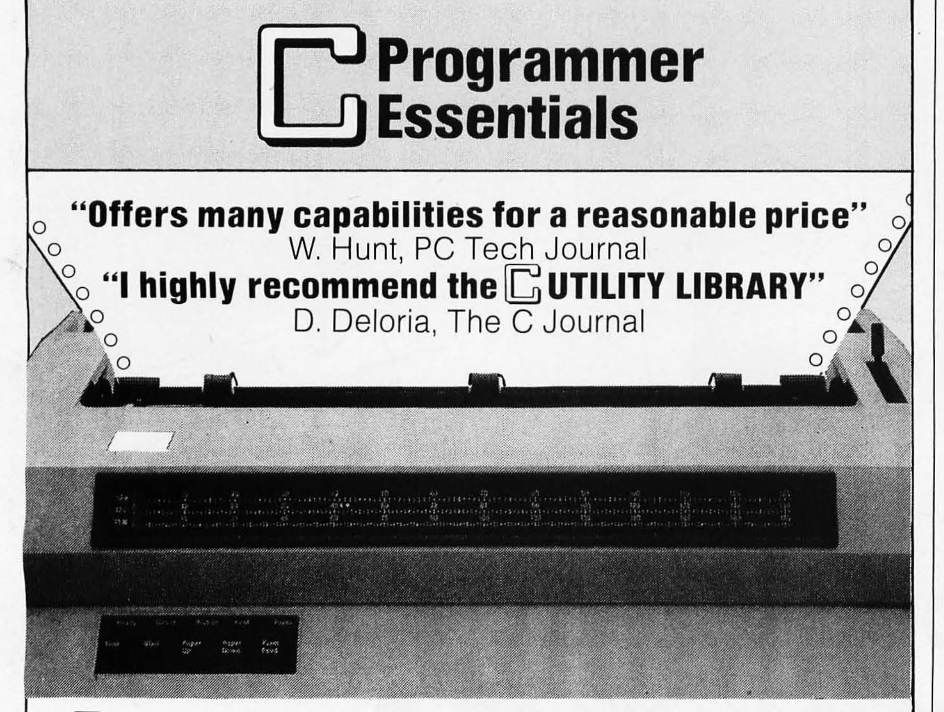
Q&A does use a lot of memory; too much for some systems. Because Q&A is such a memory hog, Symantec will make you one of the best memory deals I ever heard of: a 256K-byte memory board that also contains a clock/calendar, for only 50 bucks if you buy it when you get Q&A. If you've got a PC without full memory, this is a deal you ought to consider.

BOTTOM LINE

I like Q&A. I like the concept, and I like most of its execution. I like the documents, which are clear and explicit. I'm fond of the Intelligent Assistant. The database looks like the easiest one to use that I've yet encountered, and indeed I'm rather eager to get my troops to work using it to enter all my books. I'd love to be able to ask a database, "Who owes me royalties in November?" and get a sensible answer, and Q&A looks well able to do that. While I have some quibbles about the text editor, by and large it's as good as anything I've seen for an MS-DOS system.

On the other hand, while Q&A has great features, giving up all memory-resident programs seems a pretty high price to pay in order to use it. True, the industry is moving rapidly. Pretty soon we ought to have the hardware and software to give PC AT users megabytes to play with. When that happens, integrated programs like Q&A will come into their own. Until then, much as I like Q&A, I'll probably do without or use some-

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thing else, something that I may not like as much but that will give me back my SideKick, SuperKey, and Lightning thesaurus.

Last-minute update: I just got a new spelling checker and thesaurus program from Wayne Holder, whose The Word Plus is still my favorite CP/M spelling checker. Holder's new programs are designed to work with Q&A and will be bundled with future editions of the program. There went one of my objections.

I am also told that Symantec is working furiously on a version of Q&A that can make use of the extended memory boards manufactured by Intel and others for the PC AT. When they get that done, I'll be able to use Q&A, SideKick, SuperKey, Turbo Lightning, and so forth. I can hardly wait. Symantec has a winner with this program.





XyWrite Reconsidered

The one unforgivable sin for a text editor is losing text. XyWrite managed to do that the other day. Somehow the program created too many temporary files, filled a floppy, and gave up, trashing about 90K bytes of text that my assistant, Don Hawthorne, had painstakingly entered. In fairness, Don had pretty well filled the disk and ought to have been more careful; but the program ought to have warned him.

Fortunately, Barry Workman was able to use one of his disk utilities to go onto the disk and pull off the information file by file, so we lost nothing important; but we have retired XyWrite until we know that bug is fixed.

Late addition: XyWrite III fixes many bugs, including that one; we've been unable to lose text with III, and I tried fairly hard. I'm told that an even later edition of XyWrite III will allow the program to be used with SideKick, SuperKey, Turbo Lightning, and other memory-resident programs. I'm eagerly awaiting that one.

Ready!

As if SideKick, Turbo Lightning, and SuperKey didn't use up enough memory, now comes Ready! from Living Videotext, the people who brought you ThinkTank. Ready! is also a memory-resident program and a darned good one at that.

Ready! is an outline processor; it's a bit hard to describe how outline processors work to someone who hasn't used one. I first heard of ThinkTank a year or so ago when my friend and editor Jim Baen called to rave about it. "You've got to try it," Jim said. "I was just mucking about learning to use it, and I wrote one of my best editorials. It really lets you get thoughts down as you think them and organize as you go."

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I've said it before, but there's no harm in saying it again: if you like Pascal, you'll like Modula-2, and you won't have much trouble learning it.

All of this is true. ThinkTank was great; and if you liked ThinkTank, you'll like Ready!. More: if you're a professional writer using a PCompatible and you're not using either ThinkTank or Ready!, you're working too hard.

Ready! doesn't use as much memory as Q&A, and it works fine with all the Borland utilities in place. You can invoke Turbo Lightning's thesaurus and spelling checker while doing outlines. I've got mine installed on Big Kat, and it works fine with SideKick, SuperKey, and Lightning. I've been using Ready! pretty constantly for the past six weeks, and there's been nary a glitch. It's the kind of thing you can get to depend on pretty fast.

Ready! is available in a version that isn't copy-protected, installs easily on a hard disk, and can be brought in with an AUTOEXEC.BAT file. It is one of the first programs to be designed to make use of the extended memory boards; used that way, Ready! takes up almost no space in memory. Even without extended memory, Ready! works with Symantec's Q&A. If you work with words and ideas, you can't afford to be without Ready!. Highly recommended.

Of Mice and Modula

Logitech has a new mouse and new prices for the Modula-2 compiler. Both are good buys.

The Logimouse connects to your PCompatible through the 9-pin connector, and its software installs painlessly in the AUTOEXEC.BAT start-up. It doesn't take much room: Q&A will run with Logimouse implemented. It's a three-button mouse ("standard" for all Modula-2 systems), works fine with the Kaypro 286i, and what else can you say about a mouse?

Meanwhile, Logitech has unbundled its Modula-2 compiler; you can get it for $89. What you get is the full compiler with integrated text editor. It generates native code for IBM PCs and compatibles. The code is certainly comparable in speed and efficiency to the best PCompatible C and Pascal compilers I've seen.

I've said it before, but there's no harm in saying it again: if you like Pascal, you'll like Modula-2, and, moreover, you won't have much trouble learning it. Most Pascal source code can be translated into Modula-2 by means of programs written in Modula-2.

The main advantage of Modula-2 over Pascal—and darned near any other language—is the total independence of the modules. In Modula-2, no matter what *it* is, if you didn't explicitly import it, it can't affect what's going on inside the module; and if you don't export it, it can't affect anything else. The result is that you can build up library after library of small modules and never have to worry about variable names. (Who cares if you have 400 different counting variables called *i*? They can't affect each other if they're in separate modules.) You can also hand someone else the definition module describing what your code does, let that person write code to mate with yours, and be secure in the knowledge that nothing your partner does can have side effects inside your own modules.

Flash: Workman and Associates have a CP/M Z80 Modula-2 compiler they call FTL Modula. It's less than $100, fast, and you get the source code to its integral editor.

Modula-2 has been getting theoretical applause for years; what it has needed was a good low-cost compiler for a popular machine. Logitech has remedied that defect and is to be congratulated. If you hack, try Modula-2. Even if you don't like the language, you ought to know something about it. If you haven't done any hacking, here's your chance.

A Whole Bunch of Stuff

It's short-shrift time: I've dipped into the peach crates in the storeroom. First, Alien Names is a shareware program—copy it freely and give it to friends, but if you like it, recompense the author—that generates odd names according to specified patterns. For example, CVVCVC (C= consonant, V= vowel) generates as many names as you like, say 100, in that pattern. Examples are Puochek, Seathol, Doafid, Baudet, Daulab; it's up to you to pick the good ones. It can give you many different vowel-consonant patterns.

It also generates alien insults. Take that, yukky dozam! Alien Names does its job well. Of course, there aren't too many BYTE readers who need alien names and insults. . .

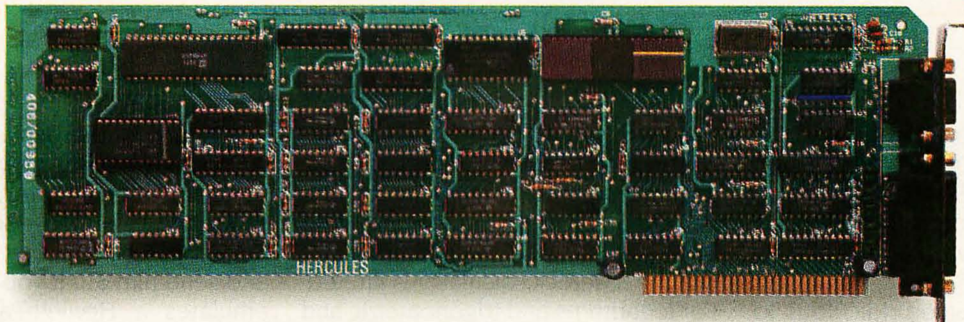
There's a new version of *Beyond Compare*, which is quite the best text-comparison program for PClones I've seen. The newest version has features for copy editors. Professional writers working with PCompatibles simply can't afford to be without this program.

Sammamish Data Systems (13730 Northeast 20th St., Bellevue, WA 98033) has programs and libraries that draw U.S. maps by census tract or zip code and can include various graphical information you supply. This program and its libraries—or something else that does the same job, only I haven't seen anything else—would be indispensable to people conducting market analyses and extremely useful to anyone trying to display census information, poll results, etc.

Keymate Systems (9225 Mira Mesa Blvd., Suite 212, San Diego, CA 92126) has a kit to convert your IBM PC keyboard into something not merely tolerable but pretty snazzy. The kit has five new keys and software with documentation. They move the offending Squiggle key so it's not in the way of the Return, make the Return

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key bigger, and deal properly with the Shift keys. When it's finished, it's very much like an IBM Selectric keyboard. If you like the feel of the PC keyboard but hate the layout, this is probably the kit to get.

It has always seemed ridiculous to have three or four computers and still keep a desk calculator, but I've noticed that most people do. It's convenient. One remedy for that is SideKick, which has a good programmer's calculator (it does hexadecimal and binary as well as decimal arithmetic); but the SideKick calculator is limited. For logarithms and trigonometric and scientific calculations, we still must either write a BASIC program or, more likely, turn to the desk calculator.

No more. Comes now a shareware program from Mitchell Schoenbrun called PC Calculator—send him $25 for a copy or get a copy from a friend and send him $10 if you like it—which emulates a Hewlett-Packard calculator, reverse Polish notation (RPN) and all. PC Calculator has logs and trig, e and pi, and financial calculations; it's also programmable—hardly surprising given that it's really a program for a computer! If you often find problems that the SideKick calculator can't handle and you're tired of keeping a calculator next to your computer, this is a good remedy—provided you can remember RPN.

I wish I had room to say a lot more about Microsoft's Quick BASIC; they've improved it yet again, removing some bugs and problems detected in beta test; experienced users of Microsoft BASIC and BASCOM are very excited. If you program in BASIC, be sure to look Quick BASIC over; I think you'll like it. More on that another time.

Heath/Zenith Show

The regional Heath/Zenith User Group show was held at the Disneyland Hotel this weekend, and I went down for a day. Fascinating: that show still retains the excitement and general atmosphere of the old days before computers became such big business.

The best news is that there are now two different boards that make your Zenith Z-100 about 99 percent PCompatible (plays Flight Simulator, for example). Considering that the Z-100 also runs CP/M 2.2 programs, including WRITE and CP/M-86, and now all PC programs, and that the Z-100 can handle a RAM (random-access read/write memory) disk, hard disk, and 8-inch disk drives all at once, it's arguable that a Z-100 may be the best computer buy in the industry. More on that another time: it will take most of a column to describe all the nice things they've done with the Z-100, and it's worth doing.

Meanwhile, Barry Watzman (560 Sunset Rd., Benton Harbor, MI

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XYWRITE III $395
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(617) 275-4439

49022), who was the principal system architect for the Z-100, has Perks, a SideKick-like desktop utility that includes scratchpad and calculator. Z-100 users who don't have it will probably want it. He can also furnish enhancements to CP/M-86 or CP/M+ for the Z-100. Write for his catalog. More on new Zenith stuff later.

WINDING DOWN

Once again I'm out of space and time. There are two games of the month, both for the Macintosh: Brøderbund's The Ancient Art of War, a game of military strategy that I have yet to actually win (although my boys have managed to defeat the PC version), and Wizardry I. I don't know what the fascination of Wizardry I is; if I describe it in objective terms, it seems boring—which it certainly is not, as witness the time it has eaten this month. I've penetrated deeper into the dungeon and found the office where I get a pass to the private elevator...

The book of the month is *Cities and the Wealth of Nations* by Jane Jacobs (Random House, 1964). She has a rather startling theory of economics that makes more sense than just about anything else I've seen; and she writes so well it's a joy to read her work. I've long been one of her admirers. Her book *The Economy of Cities* was the economic inspiration for *Oath of Fealty* by Niven and Pournelle.

There's a plethora of computer books this month. Que has some excellent new books on C. Microsoft has brought out a new edition of Van Wolverton's *MSDOS* (1985), which doesn't have enough examples and the index isn't complete, but it is the best MS-DOS user's book I've come across. There's also a new edition of Cary Lu's book on the Macintosh (*The Apple Macintosh Book*, Microsoft, 1985). It's much improved over the first edition, and the first edition was the best Macintosh book around. If you have a Mac or are curious about them, this is the book to have.

And now I really am out of space. I have a luncheon speech next week to the U.S. Space Federation; they tell me three senators and the Secretary of Defense will be there. Something tells me I'd better work on that talk. ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE *Publications,* POB 372, *Hancock,* NH 03449. *Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.*

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C·H·A·O·S M·A·N·O·R M·A·I·L

LANGUAGE

Dear Jerry,

As you mentioned in your column in July of 1985, rigid, top-down programming design is at least sometimes not the way successful programmers actually carry on their skills. One can find, as you did, convenient analogies with the writing of fiction.

While strict, top-down, and modular design may prove (*has* proven) beneficial in some circumstances some of the time, it seems to me that these circumstances and times are not *initial* circumstances; that is, they are not *beginnings*. In the first stages of creating anything, one might well have a structure in mind. But even so, only the most rigid of souls (and by that I suppose I mean "uncreative") could avoid the spontaneity that the act of creation urges upon us in those moments of insight and inspiration.

This is because ideas do not usually jump, full-blown, to the conscious mind. They have to be groped for, culled, begged, prodded, and bribed into being, and that is not always done by mere thought. Often it is the very *doing* that brings forth a framework, structure, or purpose for the doing itself. Sometimes a writer simply writes words or phrases, as though they were mnemonics or special incantations that will call forth what really is to be said. Musicians will tinker with notes and chords in order to allow a melody to gather together under their fingers. An artist may sketch almost idly in order to discover not only what is to be drawn but how something should be drawn.

We do not expect a baby to remain silent until it can speak in complete sentences. That cannot be done without a great deal of practice with sentence components, yet such practice must nevertheless be practice in *speaking*. For this reason, I believe that Pascal is not a good teaching language, because it is difficult to practice with bits and pieces. And even as adults—as experienced users—most of our conversations are partially acts of discovery: We may have the gist of what we want to say already in mind, but the words and phrases actually used are discovered by us as we are in the process of uttering them.

And at the ends of things, too, adjustments need to be made. The last part of our melody requires a change in the first part; and the ending of our novel now tells us something new about the beginning, which we did not know at the time, and we find ourselves revising what seemed for so long to be fundamental; and the creation of certain routines in a programming project forces us to revise or discard earlier ones. This is one reason why a person in charge of a team programming project ought to be good at facilitating communications—that is, a dialogue of creation—among the team's various members.

Remember that language has a motive power all its own. We make a serious mistake if we start to believe that language is a static tool that we may pick up for various purposes at will or set down when it no longer suits our needs, as though our purposes and our needs could be determined in the absence of using that very language.

This is one of the important ways in which artificial "languages," such as programming languages, are like natural languages: Their use encourages the flow of thoughts in certain ways (and discourages certain other ways). Because there is such a high degree of ceremony in ALGOL-like programming notations, it is hard to get to the heart of the matter until fairly strict preparations have been made. (And even then, all that ceremony sometimes stands in the way. I find it difficult to begin scanning a Pascal program without thinking, "Damn it! Get to the point!") But the coding of a program, like the performance of a play, is not achieved without rehearsals. When we make rehearsing easier, we tend to have a final product more to our liking.

DAVID B. SUITS
Rochester, NY

Your letter is an excellent one; and indeed, it's thoughtful feedback like this that makes writing this column so much fun.

Thanks.—Jerry

TRUE BASIC

I have received a great deal of mail, much of it thoughtful, regarding my views on True BASIC that were given last September. The following things seem clear:

1. I had a broken copy. Certain operations everyone else can perform simply will not work with the copy that was sent to me.
2. I was probably hasty in my reaction. In my own defense, I will point out that I did *write the ANSI committee in question, and my letter was neither acknowledged nor answered; and I have yet to meet anyone from the* micro *community who was invited to submit inputs to that committee. I do not believe they much listened to micro users when they devised this "standard."*
3. I have written to Addison-Wesley requesting a new and unbroken copy. So far they have not replied. When and if I get a new copy, I will take another look, paying due attention to the mail I've received and the fact that some of True BASIC's features are described only in the Reference Guide *rather than the* User's Manual.
4. I am still inclined to the view that compilers should compile and interpreters should interpret. I freely admit that I wouldn't be much interested in Microsoft BASIC if it didn't have the BASCOM (now renamed Quick BASIC) compiler to turn loose on the code.

My own practice has been to do quick-and-dirty programs—filters, file transformers, things that will be run once or twice to get a job done and then thrown away—in Microsoft BASIC; larger and more permanent programs in Compiling CBASIC (which, especially if augmented with the Minnow Bear CBC Tools, is still one heck of a well-structured language); and think hard about transforming all this stuff to Modula-2, where I can build up a basic toolbox.

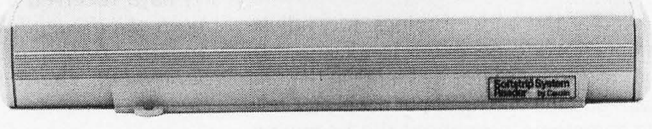
It may be that there's a real place for True BASIC; in any event, I have enough letters from people I respect to convince me I need to give it a second chance. —Jerry ■

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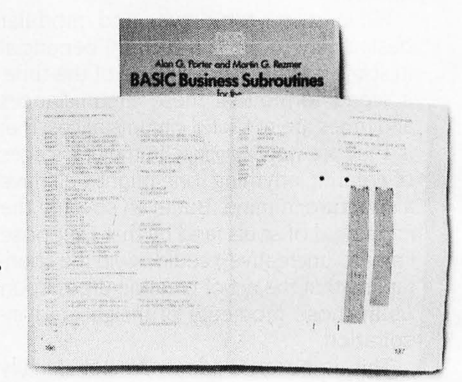
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HYPER FACTORING

Recently, there has been a revival of interest in factoring large numbers. The interest is due to the growth in popularity of public-key ciphers for security.

In its simplest form, a public-key cipher is a larger number (N) that has two prime-number factors (p and q). The number (N) is so large that it is impractical to factor it.

In the March, 1985 issue of BYTE Magazine, (Page 396), Richard B. Leining took up the challenge and wrote HYPER, a program that quickly factors large numbers.

Read the data strips on the right into your computer and then enter BASIC to RUN the program. LOAD and RUN the program called HYPER.REV.
It is menu-driven.

ACCURATE CALCULATIONS

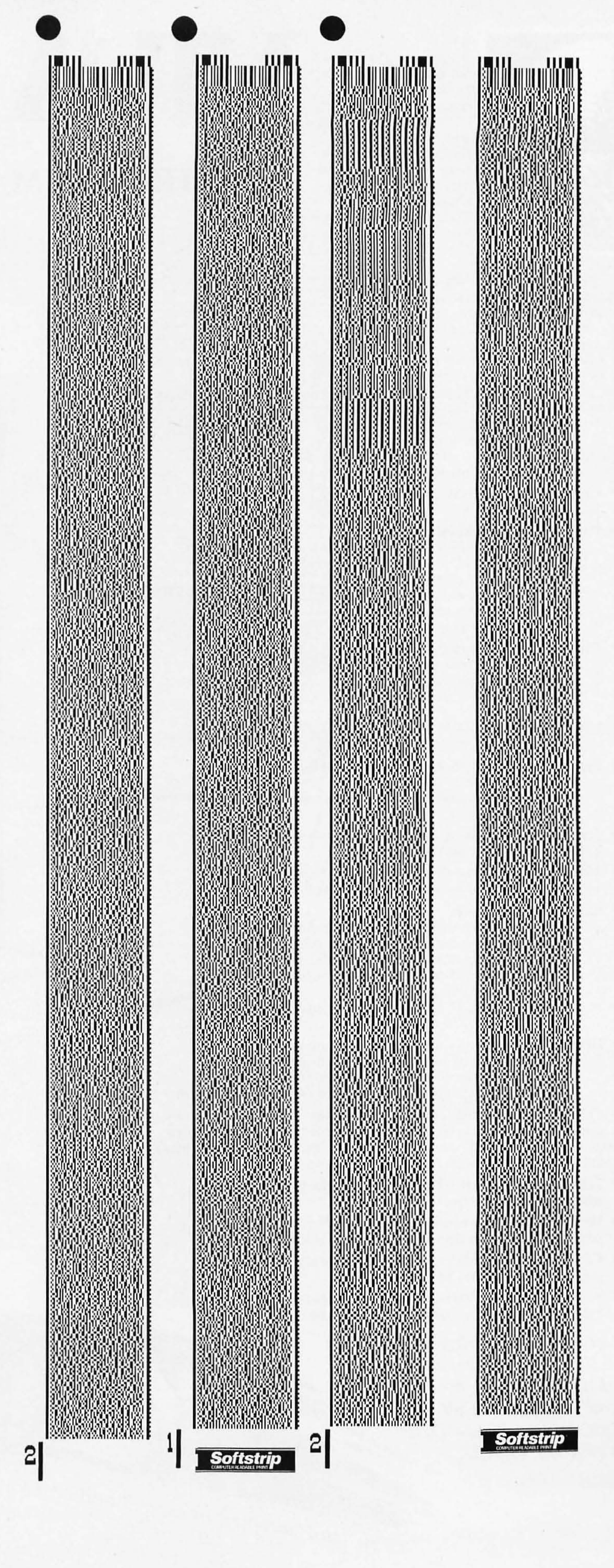
What if you asked your 10-year-old to square your Social Security number? After extensive pencil chewing you would get your answer. Your computer will do the same and give you an answer that might look something like this:

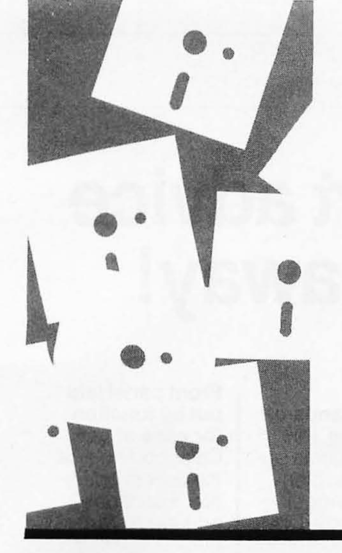
302,325,885x302,325,855
9.140092260148103D+16

Actually the correct answer is 91,400,922,601,481,025. The reason for the slight inaccuracy is that all computer assign a specific amount of space for storing integers.

The concept is fascinating and anyone working with large-number transactions will demand software that can accurately calculate to the penny.

These data strips contain the program ARITHMETIC by Peter Rice, reprinted from BYTE Magazine (March 1985, p.119). Read the strips into your computer and enter BASIC to RUN the program. The screen will ask for a number up to 200 digits in length. From that point on the program is menu-driven.





A·P·P·L·I·C·A·T·I·O·N·S O·N·L·Y

First in a Series

Turbo Editor Toolbox

Ready!

Balance of Power

Easy

BY EZRA SHAPIRO

Why this column? Software. Lots of software. Software in boxes. Software in stacks. Software filling bookcases, filing cabinets, entire rooms. Software in battered binders and shrink-wrapped slipcases. Software all over the place.

The problem is quantity. And time. Organizing a fishing expedition in this sea of products is no mean feat; you go for minnows and wind up with sharks; you go for sharks and wind up with whales.

Applications Only is a shortcut, a quick glance at applications software—word processors, database managers, spreadsheets, communications packages, utilities, etc. Pournelle and Webster look at machines, compilers, operating systems; I don't. This is the slick, commercial stuff—the (shudder) "productivity tools" and (sigh) "software solutions."

In format, Applications Only is something between review and opinion. Prejudices stated up front. Intended to pick out winners, losers, and occasional oddities, but no guarantees. And monthly, so you can learn my biases and figure out if it makes more sense to follow my recommendations or avoid them.

OPENING SALVO

Turbo Editor Toolbox (Borland, $69.95) struck me as a nifty way to kill two birds with, well, two stones. The Toolbox is a wonderful idea—source code in Turbo Pascal for a complete editor, a thorough well-written manual, and no royalties to pay if you use the routines in your own programs.

This was my plan: Turbo Pascal costs $69.95; the Editor Toolbox costs $69.95. Buy both, compile the code, and you get a word processor *and* a Pascal compiler for under a hundred and forty bucks. Not bad! Or so it seemed.

How does the Toolbox stack up as an editor? The cover of the Toolbox manual is pretty convincing. "Features that word processors selling for several hundred dollars can't begin to match," it trumpets. "Create your own word processor. We provide all the editing routines. You plug in the features you want. You could build a WordStar-like editor with pull-down menus like Microsoft's Word, and make it work as fast as WordPerfect." Borland has even gone so far as to name the editor "MicroStar." What would *you* think you were getting?

And the list of features is impressive, as far as it goes. A WordStar command set. Multiple windows. Multitasking. Undelete. Memory-mapped screen handling. An interface to Turbo Lightning for spelling checking as you type. Block operations. Search and replace. And you get the source, so you can change anything you don't particularly like.

I have to admit that the folks at Borland never actually say you're buying the code for an improved version of WordStar; they just make it very easy to leap to that conclusion.

However, a little something is missing. There are no facilities—none—for any kind of output formatting. No page breaks. No page numbers. No headers. No footers. No dot commands. No mail merge. No printer font changes. No proportional spacing. No pausing to insert single sheets of paper. None of that stuff.

What Borland has produced is a great gift to programmers and an excellent product, but it's not a substitute for a true word processor. Turning it into one is a big project. So, if you want to spend a lot of time programming, buy the Editor Toolbox. If you want WordStar, buy WordStar.

BETTER NEWS

Ready! (Living Videotext, $99.95) is one of those nice programs that's difficult to write about because it does exactly what its publishers claim, and it does it well. It's a memory-resident outline processor that closely resembles ThinkTank, Living Video-

(continued)

Ezra Shapiro is BYTE's West Coast bureau chief. He can be contacted c/o BYTE, McGraw-Hill, 425 Battery St., San Francisco, CA 94111.

text's full-scale outliner. Ready! lacks some of the sophisticated word-processing features of ThinkTank, but because it lives in RAM it's faster and, of course, it's designed for other purposes.

The program takes a short amount of time to learn. You use cursor keys and function keys to create an indented outline. You can insert, delete, alphabetize, or reorganize items with little hassle. Not much to it.

Ready!'s chief distinction is its ability to transmit outlines into other applications programs. With one keystroke, you can drop a Ready! outline into a word-processor file and then proceed to edit it there as raw text. The program comes with 27 different output configurations for popular products, of which you can have 10 loaded at any one time. Why that many? Ask the people who developed other software. Word processors usually—but not always—like lines ended with carriage returns; spreadsheets use arrow keys. No standardization.

Living Videotext suggests that Ready! can be used for generating spreadsheet labels and database forms, storing keyboard macros, and suchlike, as well as developing textual outlines. I use it for keeping various lists that often have nothing to do with the material on screen in my primary application.

Other reviewers have compared Ready! to Borland's SideKick, differentiating between the two by noting that Ready! builds outlines while SideKick produces flat text files. That's missing the point.

Let me coin some terms here. I see SideKick as an *inbound* utility, and Ready! as an *outbound* one. What do I mean by that? SideKick can pick up on-screen data and let you massage it; it's handy for collecting chunks of data from other programs and organizing a new document file. It outputs to disk or printer, not directly into another program. Ready! can't capture material from other sources; you use it to originate data, which you can then send to disk, to a printer, or into an open applications file. I use SideKick for *manipulating* and Ready! for *creating*. The two programs are not merely different approaches to taking notes; if anything, they're complementary.

My only complaint is that Ready!, when configured to hold a 32K-byte outline file, chews up 127K bytes of memory. That reduces my 640K-byte computer system to 512K bytes. I liked having that memory pad, since I prefer RAM-based editors and databases. Oh, well. You have to make sacrifices, I guess.

Anyway, Ready! gets high marks from me. It's more than worth its modest price.

TOUR DE FORCE

Webster's Dictionary defines "transcendent" as "exceeding usual limits . . . extending or lying beyond the limits of ordinary experience. . . ." It's the best word I can find to describe **Balance of Power** (Mindscape, $49.95). Ostensibly a game for the Macintosh, this simulation is one of the finest programs—of any type—that I've seen on a microcomputer.

Subtitled "Geopolitics in the Nuclear Age," the game is an exploration of superpower diplomacy played on a world map. You choose to be either the U.S. or the U.S.S.R. (In a one-player game, the computer takes the other side. You can also play against a friend.) In brief, you decide whether to support or undermine the governments of each of 60 countries; you can send economic or military aid to either government or rebel forces, conduct covert operations to destabilize unfriendly regimes, apply diplomatic pressure, sign treaties, station troops. The object is to increase your sphere of influence and international prestige—at your opponent's

(continued)

expense—while avoiding nuclear war, in which both sides lose. The dynamics of the game consist of challenging your opponent's moves; at every step the other side takes you can choose to send a diplomatic protest, which can expand into a full-scale crisis. Your opponent has the same opportunity. It's a grand global game of "chicken," played for the highest stakes possible.

I don't have the space to get much further into a discussion of how the game is played. It's an intriguing adult simulation, provocative as well as entertaining. A carefully thought-out game could take days, and, as an educational tool, I could see Balance of Power as a month-long project for a high school social science class.

But what strikes me most forcefully about the game is how beautifully it uses the Macintosh's resources. You can display vast amounts of political, social, economic, and military data about the world, ranked in several ways, on cross-hatched maps. Every "event" triggers changes in status reports, maps, and mock newspaper displays. And the algorithms for analyzing the progress of the world situation over the course of a game's eight-year span are very complex.

Limitations? My mouse arm gets tired. I wish the Mac allowed more keyboard shortcuts. And I suppose someone with a Ph.D. in political science could take issue with the game's content. But as Chris Crawford, the game's designer, points out in the comprehensive manual, as long as you're asking questions about the realism of Balance of Power, it still has something to teach you.

If I gave out little stars or little disks for computer programs, this one would get the highest rating. This is what computers should do.

PARTING SHOT

I wanted to like **Easy** (MicroPro, $150). I really did. I've got a certain amount of residual loyalty because (even though I've tried to find a replacement) I've been using WordStar as my "serious" word processor for about three and a half years. Easy files are compatible with WordStar files; you don't need any annoying export/import utilities. And on paper, Easy seems to have a lot of desirable features lacking in WordStar—pull-down menus, automatic paragraph reformatting, support for a massive list of printers (including my neglected Mannesmann Tally), a simplified command set, and undelete. Plus it's cheap. So far, so good.

However, every time I sit down to play with Easy, I stumble onto something that drives me to distraction. I realize that MicroPro has geared the program for first-time users, so I'm not the typical customer. However, if you've used any other text editor or word processor, Easy is a letdown.

To begin with, it's slow, particularly with the auto-reformatting. It feels like I'm typing through molasses. I haven't timed the response with a stopwatch, but it's not great.

Next, if you move your cursor beyond the end of a line and type a character, Easy automatically fills the dead area with spaces. This might be considered a useful feature by some, but it means that you can't move from the end of one line to the beginning of the next by leaning on the cursor key; you must use Ctrl-right-arrow.

Then three bothersome things happen when you're inserting text into a preexisting block. First, the automatic paragraph reformatting becomes visually annoying. If you add enough characters to force the last word on a line to the line below, Easy drops the word to a brand new line with nothing else on it. The program thinks for a second, then brings the remaining text up to where it should be. So you have a constant flashing effect as Easy opens a gap and then closes it, and this happens every time you push a word to the next line.

Second, if you want to break a line in the middle, you've got to hit Ctrl-enter. Hitting the enter key merely drops you to the line below. This gets irritating when you're trying to reformat material to shorter line lengths.

Finally, if you move to the next character position beyond the end of a line, Easy will not let you add a space. If you try to type a space followed by more text, Easy will remove the space and run the words together. If you teach yourself to get to the end of a line using the Ctrl-arrow combinations, you'll discover a soft space at the end of every line; use those combinations and you can add text just fine.

Conclusion: If you've never used a computer word processor before, get a demonstration of Easy before you buy it. See if you can live with the slowness and flashing-on-reform. If you have used other text-handling programs, note that you'll have to learn unfamiliar ways to move around the screen. As a second word processor, Easy is tough. ■

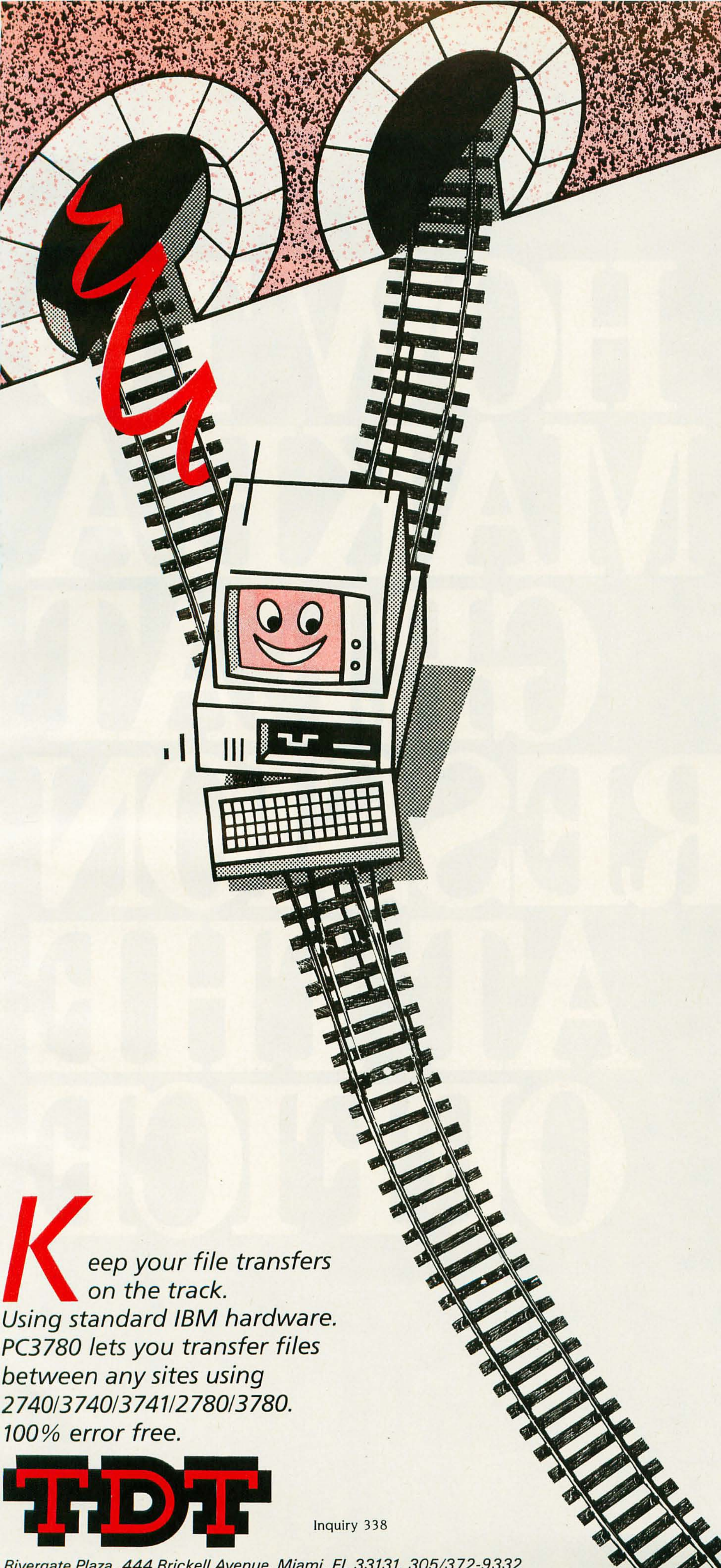
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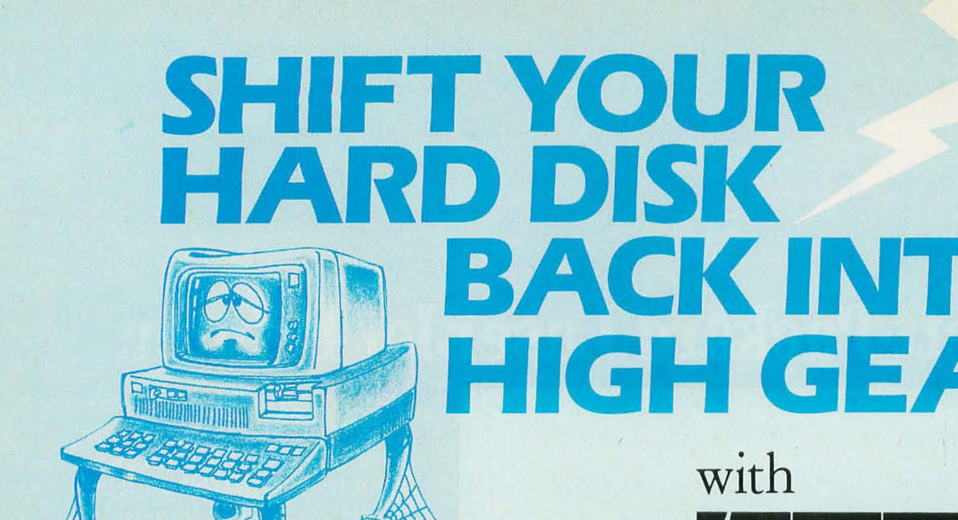
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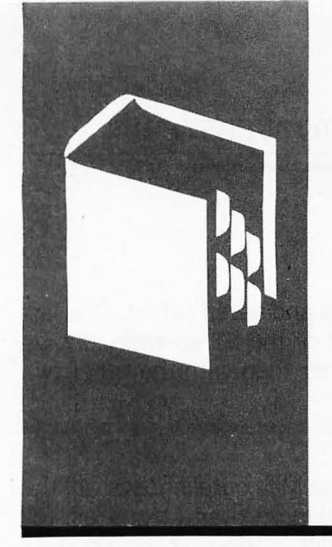
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BY BRUCE WEBSTER

It is late November—almost Thanksgiving—as I finish writing this, and the editors back in Peterborough are screaming for my column. It's nice to be wanted, eh? However, if I don't wrap this up and upload it posthaste, I may be wanted in two or three states. Worse yet, a certain managing editor may end up being wanted for manslaughter, though I doubt if any reasonable jury would convict him. I must type faster...

I now have all three of the prominent 68000 machines: Apple's Macintosh, the Atari 520ST, and Commodore's Amiga 1000. I've had the Mac for nearly two years and the ST and Amiga for less than two months. And the single most common question I get these days is, "What do you think of the [one of the above] as compared to [one or two of the others above]?" Also, a lot of claims and counterclaims have been floating around concerning the relative merits of and problems with the three machines. In this column and the next few, I hope to sort out fact from fantasy and present some well-supported—if not completely objective—opinions. (Note: "Objective opinion" is an oxymoron, that is, a self-contradictory phrase, like "intelligent idiot" or "deliverable vaporware.")

MAC VERSUS ST VERSUS AMIGA

The format of this column is simple. I'll take a number of different areas, one by one, and give my opinion on how the three machines stack up—who wins, who places, who shows. Where possible, this is based on direct experience. However, since I am not all-seeing or all-knowing, I have asked questions of those with more experience or knowledge, and I've done my best to acknowledge them at the end of the column.

APPEARANCE AND PHYSICAL SETUP

The Macintosh wins this category easily. My 2-megabyte Mac has a 20-megabyte hard disk (MacBottom) and two disk drives (internal and external). The design is clean, attractive, professional, and unique. Better yet, the system takes up *less than one* square foot (9½ by 9½ inches) for the main unit and another 6 by 13 inches for the detachable keyboard, which can be easily moved 3 to 4 feet from the main unit. The Mac itself needs only one power outlet, though the hard disk requires its own as well. It definitely looks good in an executive suite and won't eat up all your desk space.

The Amiga comes in second, resembling the IBM PC (though, in my opinion, it looks nicer). The main unit is 17½ by 13 inches, covering more than twice as much desk space as the Mac. The monitor stacks nicely on top of the main unit, but a second (external) disk drive must sit to one side and takes up an 8- by 6-inch area. The detachable keyboard (6 by 16 inches) is larger than the Mac's, but it slides nicely under the main unit when not in use, and it can be moved almost as far as the Mac's. One warning, though: Since the expansion bus is on the right side of the Amiga, adding hardware is going to cause the Amiga to grow wider. The basic system (with two drives and monitor) needs two power outlets.

The ST comes in last, for reasons groused about last month. The main unit is 18½ by 9½ inches. It therefore takes up less space than the Amiga, but neither the monitor nor the external disk drives can stack on it, so a complete system takes up much more desk space than either the Mac or the Amiga: A conservative estimate is about 21 by 21 inches. The keyboard is built into the main unit, so you don't have the additional space requirements for that, but you also don't have the flexibility of a detachable keyboard. The ST has a nice design but looks much like a home computer (which it is). Most unfortunate are the thick cables and external power supplies—one for the main unit and one for each disk drive. A basic system with monitor and two disk

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drives uses four power outlets and seven cables. One last problem: With the main unit of the ST so wide, finding room for the mouse is tougher than with the other two systems.

Monitors

For a monochrome display, the Mac barely noses out the ST, mostly due to cleaner-looking text and icons, as well as the monitor's size (i.e., built in, doesn't eat up desk space). However, if you are using the Atari monochrome monitor, you'll find it just about as crisp as the Mac, and the display itself is larger, both physically (12 inches versus 9 inches) and in terms of pixels displayed (640 by 400 versus 512 by 342). Both also have a true 1:1 aspect ratio. If you have an Atari color monitor, you can choose medium-resolution mode, which is 640 by 400 pixels with two colors; however, the aspect ratio is not quite 1:1, so icons and text look a little elongated. The Amiga doesn't have a monochrome mode or a monochrome monitor. You can set up a display using only two colors, but it doesn't look nearly as crisp as on the Macintosh or the 520ST.

For a color display, I think the Atari RGB (red-green-blue) monitor produces crisper, more brilliant colors than the Amiga RGB monitor (Model 1070). The Atari display has a cleaner look, while the Amiga display tends to look a little mushy. I'd like to swap monitors between the Atari and Amiga to determine where the real praise or blame for the display quality should go, but the Atari hardware uses a rare round 13-pin DIN connector that makes it hard to hook up other monitors to the ST or the Atari monitor to other computers. The Mac, of course, isn't even in the running for color display—yet.

While the ST is the overall winner for display clarity, the Amiga completely blows the other two away for display versatility, i.e., video-signal options. The Mac has no external video output. The ST has both color (analog RGB) and monochrome coming out of a single port, but—as mentioned—it is hard to hook up anything but an Atari monitor. If you want both crisp monochrome and color graphics, you have to have both monitors, eating up more money and desk space. Also, a number of ST software packages will run only with the color monitor—I don't know of any that will run only with a monochrome monitor—so that complicates things even more.

The Amiga, however, presents you with multiple options. You have RF (radio frequency)-modulated video and audio, for hooking up the Amiga to older TV sets. You have high-quality NTSC (National Television System Committee) composite video for newer TV sets as well as color monitors you might have lying around from other computer systems. You have both analog and digital RGB output for RGB monitors and top-of-the-line TV sets. And Commodore has a genlock board that lets you take an external video source (laser disk, VCR, camera, TV) and mix it with your graphics display. The external video then

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becomes the background "color" (color 0), with all other colors appearing on top of it.

GRAPHICS

While the ST and the Mac beat the Amiga in display quality, the Amiga breezes ahead of both in terms of graphics speed and variety. I'll have an extensive set of graphics benchmarks in next month's column, but here's the basic information about each machine.

The Mac has a single graphics resolution: 512 by 342 pixels, monochrome. Video RAM (random-access read/write memory) is a single 21K-byte block of memory; each bit represents exactly one pixel. There is no hardware support for the graphics, so every pixel that appears on the screen is put there by the 68000 processor. Extensive and sophisticated software support is provided via QuickDraw and other ROM (read-only memory) routines.

The ST has three graphics resolutions: 320 by 200 pixels, 16 colors; 640 by 200, 4 colors; and 640 by 400 (noninterlaced), monochrome. All colors are taken from a palette of 512 (3 bits each of red, green, and blue). A special mode lets you redefine the palette on each scan line; however, when invoked, you have to handle it for every scan line. Video RAM is a 32K-byte block of memory. An interlaced bit-plane approach is used. If you have four bit planes (16 colors), every four consecutive words represent one word from each of the four planes. Again, the 68000 processor has to draw each and every pixel on the screen. Software support is provided via GEM (from Digital Research), which has some limitations compared to the Mac routines. However, overall graphics performance on the ST seems to be better than on the Mac.

The Amiga has four basic resolutions: 320 by 200 pixels, 32 colors; 320 by 400 (interlaced), 32 colors; 640 by 200, 16 colors; and 640 by 400 (interlaced), 16 colors. You choose from a palette of 4096 colors (4 bits each, RGB). Bit planes are truly separate, can be located anywhere in the lower 512K bytes of RAM, can be larger or smaller than the display screen, and can be allocated as needed. For example, if you want a 320 by 200 display with 4 colors, you need to set aside only 16K bytes of RAM (8K bytes for each bit plane). Special graphics modes include half-bright (which lets you have up to 64 colors in the 320-resolution modes), dual playfield (which sets up two independent graphics displays, one "in front of" the other, with color 0 for the front display being "transparent" and letting the back display show through), and hold-and-modify (which lets you have up to 4096 colors on the screen simultaneously). You can change resolution (320 versus 640) and palettes at will while moving down the screen, and you can scroll both vertically and horizontally merely by changing some register values.

Most of the grunt work is done by custom graphics hardware, leaving the processor free to do other work (more on this in a minute). And I haven't mentioned hardware and virtual sprites, object animation, hardware collision

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detection, multiple screens and windows, display list processing by the Copper (graphics coprocessor), minterm processing by the Blitter, and so on. Software support exists on three levels: direct access of the custom chips, low-level graphics routines, and high-level graphics routines. The routines are not as complete or polished as the Mac's but still have some significant capabilities not found in the other two machines.

A Digression

I want to make some comments here about the custom chips on the Amiga, mostly in response to some misleading and distorted comments floating around on the bit stream. The internal bus of the Amiga runs at 14.2 megahertz, twice the clock rate of the 68000 processor. Alternate cycles are given to the 68000 and the DMA (direct memory access) channels, so that the 68000 is usually running at full speed. However, two different situations can occur to cause the 68000 to run slower.

First, if the 68000 is running code located in the lowest 512K bytes of RAM (the Amiga's internal memory, known as chip RAM), contention may—but does not necessarily—occur between the 68000 and the DMA channels. You can, for example, run a four-plane low-resolution (320 by 200 by 16) display (or a two-plane high-resolution display), with all four audio channels, all eight sprites, and be accessing the disk as well—and the 68000 will still be going full tilt. However, if you have a six-plane low-resolution display, the 68000 will slow down by 50 percent during the video update cycles, due to bus contention, if and only if the 68000 is accessing chip RAM. (Note, though, that the 68000 still has no contention during horizontal and vertical blanking.) However, if you've expanded the Amiga beyond 512K bytes, and your code is running in the external memory (known as fast RAM), there is no contention at all, and the 68000 continues to run at full tilt, regardless of the current screen resolution.

The second situation in which the Amiga's 68000 loses cycles is when the Copper or the Blitter is running. Both will steal cycles to accomplish their work; however, since both can accomplish in a few cycles what would take the 68000 many cycles, the net effect is significantly greater performance than either the Mac or the ST, both of which rely upon their 68000s to draw every pixel.

Sound

The Amiga is the winner in the area of sound. It has four audio channels, each with its own 8-bit D/A (digital-to-analog) converter and DMA channel. Left and right audio outputs on the back (standard RCA jacks) let you hook up the Amiga to your RGB monitor (you'll need a Y-adapter) or your stereo system; two channels are assigned to each output. (By the way, both outputs also go out through the TV video port, though the current RF modulator combines them to produce monaural sound.) Because the audio channels are DMA-driven, they can run

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with little processor overhead. You can also combine channels to do frequency and amplitude modulation. The Amiga's software support of sound is also excellent, including standard routines to play back digitized sound and to do speech synthesis.

The ST takes a different approach to sound. It has no D/A converters or audio outputs. Instead, it uses a standard three-voice sound chip, which was designed primarily for music synthesis and arcade sound effects and has previously shown up in machines like Mattel's Intellivision. Again, use of this chip helps to relieve any burden on the processor; however, you do not have the same ability to play back digitized sound found in the Amiga (or, with some work, in the Mac). This audio signal is then fed to the monitor via the cable. However, what excites a lot of music enthusiasts about the ST are the standard MIDI (musical instrument digital interface) in and MIDI out ports on the back. This makes it easy to use the ST to control synthesizers and other audio exotica, with some impressive results. Software support for both the sound chip and the MIDI ports seems to be minimal, though; all I could find in the technical documentation were a couple of BIOS (basic input/output system) calls, and I found no information at all as to how the hardware worked.

The Macintosh has a four-voice synthesizer using a single 8-bit D/A converter. Only a little overhead is involved with a single voice, but if you're running all four voices, you place a significant load on the 68000. It is possible to play back digitized sound, but it requires custom software; the ROM routines do not directly handle it.

System Software

The Mac wins here. For all the grousing that I and others have done about the Mac's Finder, OS (operating system), and even its Toolbox, they are still perhaps the finest system software put on a microcomputer, and they really shine when viewed next to the ST and the Amiga. Of course, Apple has had longer to polish them, but I think the Mac at its release still had far better stuff than either of the others, especially since it had to run on a 128K-byte machine.

It is hard to come up with a clear winner between the ST and the Amiga in the area of system software, but I'll go with the ST, mostly because of GEM and GEM Desktop. Even though they have some limitations and often lack intelligence and flexibility, they are still more polished than their counterparts on the Amiga. And because of the accepted limitations, GEM can often outperform both the Mac and the Amiga in standard system functions (opening windows, etc.). Atari was smart to go with a system to which someone else had already devoted a lot of resources, leaving Atari with more time to concentrate on the hardware.

Commodore, on the other hand, has done everything in-house and just hasn't done the job on the Amiga system software that it should—probably due to too few peo-

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ple and too little money. The Amiga is a complex piece of hardware; writing ROM and OS routines to take advantage of that complexity isn't easy, and the gaps often show. I do not like AmigaDOS, which is a modified version of Tripos, a 68000-based OS developed in England (see the February BYTE U.K., page 321). It is nonstandard, ignoring common microcomputer conventions like Control-Q/Control-S, wild cards, and so on. The command-line interpreter is simply a little routine to execute programs, so that even common commands like DIR (show directory) and CD (change directory) require it to go back to the boot disk to load in a DIR or CD program. Intuition, a window-based user interface, works nicely but will not show you any file on a disk that does not have an icon explicitly defined for it; in other words, each file must have a corresponding <filename>.INFO with the icon definition inside for you to be able to open, move, delete, or execute the file; otherwise, you have to use the command-line interpreter.

If there is a bright point to the Amiga's system software, it is the multitasking Kernel, which makes everything you do inherently multitasking; you can, for example, edit a file while compiling another one. Since the Kernel exists below AmigaDOS and Intuition, no special provisions need to be made for handling the multitasking. Mac and ST developers make a lot of noise about multitasking on their systems, but in both cases it will have to be something of a retrofit and a kludge.

APPLICATION SOFTWARE

The Mac has the advantage, simply because it has been out so much longer than the other two machines. There is a wide variety of polished, professional applications for just about every use (though, curiously, the selection of word processors is limited). The Mac market continues to mature and grow, and some second- and third-generation packages are beginning to emerge, held back mostly by the previous limits on memory and mass storage.

The ST has an impressive number of titles available right now, as demonstrated by the large and crowded Atari booth at COMDEX, probably more so than the Mac had four months after its release. Most though, are geared toward development, entertainment, and personal productivity; few slick, powerful programs have come forth, simply because they take longer to write and because the ST's memory is being eaten up by TOS/GEM, which is not yet in ROM. Also, I suspect that most business software houses don't see the ST as a business machine, so they haven't put any effort into developing programs for it.

Few titles are currently (November) shipping for the Amiga. This is so for a couple of reasons. First, the Kernel and system software have been changing continually all year, and many developers have had to do significant rewrites to accommodate each change. Version 1.1 of the system software is due to be released within a few days, and a number of firms plan to start shipping titles as soon

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as that happens. The second reason is that most developers (such as those who attended the Amiga developers' seminar last May) weren't able to get machines until late August or early September, while the ST has been in the hands of developers since last spring. One possible saving grace: Some of the big guys, including Microsoft, are doing serious development work on the Amiga and may help it to get some professional software.

PORTS

This is a close one. All three machines have good and bad aspects, but I'll pick the ST as the winner on the basis of three ports: the hard-disk DMA, the serial port, and the printer port. As I mentioned last month, I was impressed when I could simply unplug my printer and modem cables from my Compaq, plug them into the ST, and immediately use my Epson printer and Hayes modem. No fuss, no muss. And the hard-disk port helps to offset the lack of an expansion bus. The two MIDI ports and the two joystick ports are also assets, while the very obscure 13-pin video port and the lack of composite or RF video output are liabilities.

The Amiga gets good marks for the variety of ports: parallel, serial, floppy disk, RGB, composite video, RF video, left and right audio, and dual ports that can accept mice, potentiometer- or switch-type joysticks, or light pens. The bad marks come from some of the nonstandard pinouts. The parallel port uses a DB-25 (male) connector rather than the DB-25 (female) connector of the IBM PC. So (unlike the ST) you cannot just plug in an IBM printer cable; instead, you have to use a special Amiga cable. Likewise, the serial port is not standard RS-232C but has some unusual signals for a serial port, like audio in, audio out, and several voltage levels (−5, +5, and +12). The RGB port uses a DB-23 connector that, while easier to build than the Atari's 13-pin DIN, is still odd enough to slow you down.

The Mac gets negative points for the lack of ports—just two serial ports—and their nonstandard nature, i.e., "almost" RS-422. This is especially serious in light of the lack of any external bus or internal slots. Which brings us to the next topic . . .

EXPANDABILITY

The Amiga comes in first, simply because it's the only one of the three really built to be expandable. Both the Mac and the ST are closed boxes, though heroic efforts are being made for after-the-fact expandability. Having been through the Amiga technical documents completely, I can tell you that the machine was designed from the ground up, both in terms of hardware and software, to grow. The 60-pin expansion bus gives external hardware complete access to and control of the insides of the machine, including the custom chips. The memory map allocates a little over half to RAM (8½ megabytes); much of the rest is reserved for future use. Part of the memory map is set

(continued)

aside for expansion hardware, so that if developers follow the protocol given, the system will configure itself when booted, avoiding the need for DIP (dual in-line package) switches and so on.

One of the best examples of the Amiga's open architecture comes from Computer System Associates, a firm that makes a board for 68000 development systems. The board, which plugs into the 68000's socket, has a 68020 processor and a 68881 floating-point processor. Vic Wintriss, the president of CSA, bought an Amiga, opened the machine, removed the 68000, and plugged in his board. Not only did the Amiga work fine, but Vic says he got an immediate 70 percent increase in speed, which doesn't count the floating-point hardware. Similar attempts to upgrade the Mac have failed; I don't know if anyone has tried it with an ST.

As mentioned, neither the Mac nor the ST is designed to be expandable: the Mac, because of philosophy; the ST, because of cost. It is possible to expand RAM in both, but this is usually at the cost of your warranty and sometimes your power supply. ROM changes and system-software patches are often required as well, and some application programs may not work or may not recognize the extra memory. And neither is really set up for significant non-RAM hardware expansion. The ST does have an edge over the Mac, though, because of both the hard-disk port (which uses DMA for speed) and the cartridge port (which makes some data and address lines available). Also, because the 520ST is not designed for hardware expansion, most of its 16-megabyte address space is available for RAM, while the current Mac is pretty much limited to 4 megabytes.

Technical Manuals

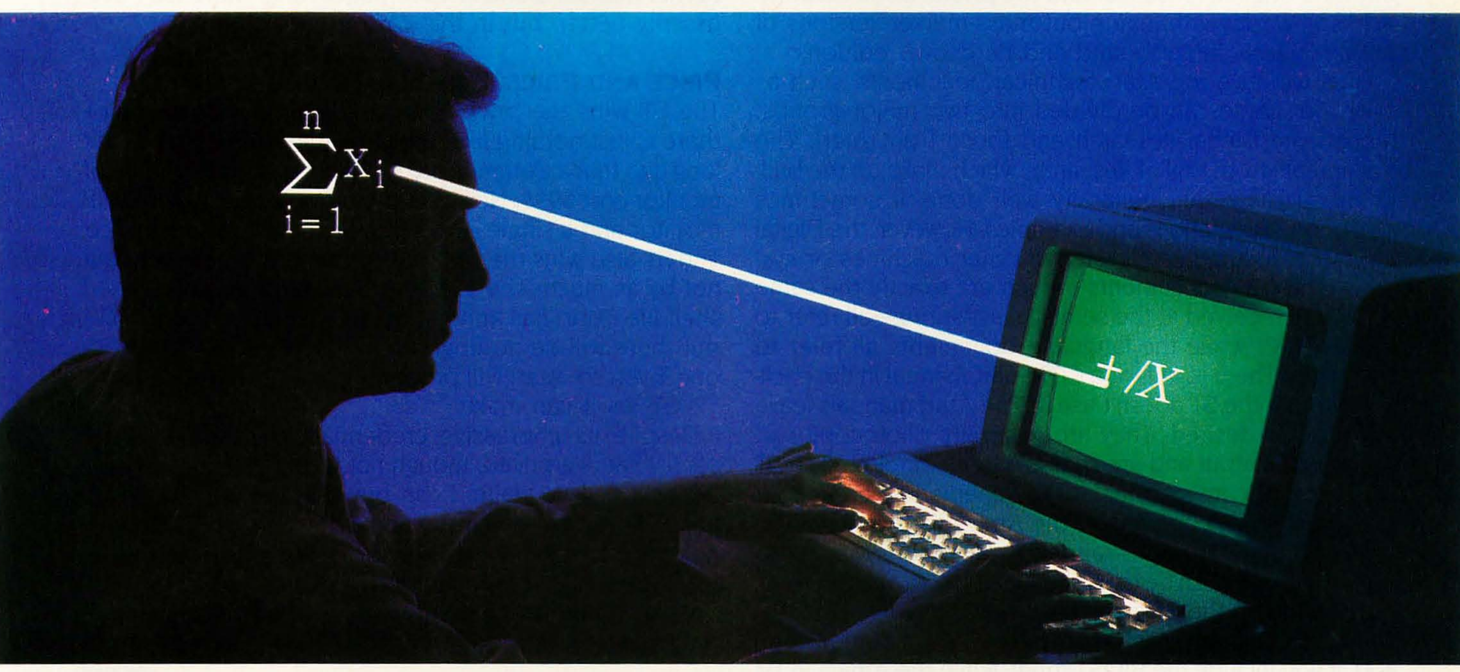
The Amiga wins here easily. The seven technical manuals—more than 2000 pages, all professionally printed and bound—are the best I've seen for a new computer and may well be the best I've ever seen for any computer. They are well written, well organized, and amazingly complete, covering hardware, Kernel routines, AmigaDOS, and Intuition. Addison-Wesley is bringing out mass-market versions of the manuals; the ones I have were put together by Commodore, which makes the feat even more impressive.

Inside Macintosh is, well, the manual we all know and love. And hate. It is a large collection of technical notes about various aspects of the Mac's system software, with almost no mention of, nor significant information about, the hardware. There is little overall organization to the manual; however, most sections follow a consistent format that makes it easy (once you've found the right section) to dig out what you need. However, as Kathe Spracklen (coauthor of Sargon II) once observed, each section (there are 30 or so) requires that you understand all the others, which can make your initial exposure to *Inside Macintosh* a challenging experience in intellectual bootstrapping. I have

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both the original loose-leaf and the phone book editions. Addison-Wesley is bringing out mass-market versions of *Inside Macintosh* in softbound and hardcover editions.

Then we have the Atari technical documents, such as they are. These can be divided into two major groups: those from Digital Research and those from Atari. The documents from Digital Research, which make up the bulk of the package, are generally well done, if sometimes sparse on explanations and examples. However, the Digital Research documents all refer to other machines or systems. The GEM documents—which are exactly the same as those I received at the seminar last spring—all refer to the IBM PC, while the language documents all refer to CP/M-68K. There is, in fact, a CP/M-68K manual in the package, though the ST doesn't use it. The Atari manuals leave much to be desired. They are generally photocopies of dot-matrix output and are sparse and incomplete. The ST hardware documents, including schematics, are about 15–20 pages; by comparison, the Amiga hardware manual is more than 300 pages (and, of course, the Mac hardware manual doesn't exist). The DOS, BIOS, and "Line A" documents for the ST are better than its hardware documents but still represent less than 300 pages (more than 400, if you include the BIOS listing), while the Amiga ROM Kernel manual alone is 1500 pages long. More isn't necessarily better, but in this case it definitely is.

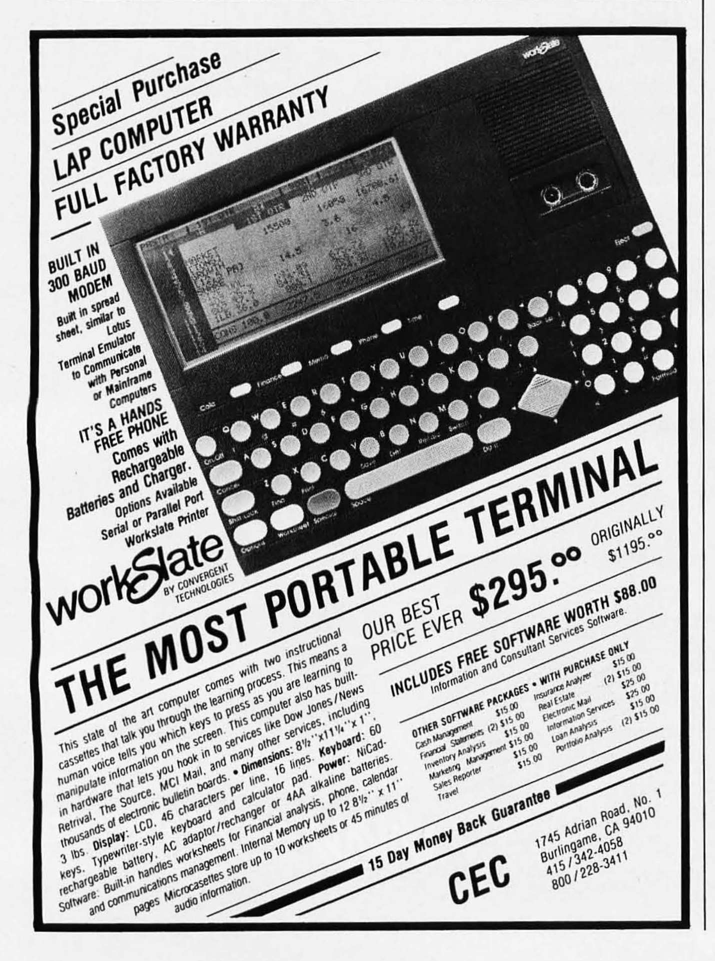
PRICE AND PRICE/PERFORMANCE

The ST wins the price comparison by a wide margin—there is just nothing like it for less than $1000. It was not long ago that a Commodore 64 with a disk drive and color monitor cost $995. Now you can buy a 520ST with an RGB monitor and a single-sided disk drive for the same price. The ST also wins the price/performance comparison, but not by as much. The 520ST is a closed box with a fixed shelf life; Atari has announced its successor, the 1040ST, but there will be no upgrade path to it, at least no easy one. Even so, Atari will probably continue to sell as many 520STs as it can make.

Despite its impressive credentials, the Amiga is still somewhat overpriced, though not (in my opinion) as badly as most people claim. I can buy a $1295 Amiga—which has 256K bytes of memory and a double-sided disk drive holding 876K bytes—take it home, hook it up to my TV set or a spare color monitor (using RF, composite, or RGB), boot up BASIC, and have more than 40K bytes of memory available. To do the same with a 520ST, I would have to

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There is no clear winner. Each machine has its strengths and its weaknesses.

spend $1095, which would get me the nice Atari RGB monitor (since the ST can't use a TV set or a composite color monitor), a double-sided drive (holding only 709K bytes, or about 81 percent of the Amiga's drive), and 512K bytes, of which only about 256K bytes is available since GEM/TOS is not in ROM yet. (However, I have just had late word that Atari has started shipping EPROMs with GEM/TOS to developers and that ROMs for end users should be available shortly. That will make a big difference in the amount of memory available for applications.) And while I would like to see the Amiga down at, say, $995, Commodore has little incentive right now to lower the price since—like Atari—it's selling all it can make.

I'm not sure what the Mac's official list price is, but the street price right now for a 512K-byte single-drive (400K bytes) Mac is slightly less than $2000. The Mac, therefore, comes in a distant third in both price and price/performance. Since the Mac still has a tremendous advantage in terms of software, support, and company stability, the price isn't likely to come down too far or too fast.

WRAP-UP OF ROUND 1

Based on the observations above, there is no clear winner. Each machine has its strengths and its weaknesses. The Mac is an established machine, with lots of software and hardware available, a large installed base, and sound financial backing (at least in comparison to Atari and Commodore). The 520ST is an amazing bargain, much more a computer "for the rest of us" than the Mac ever was, and it should sell well. The Amiga is slow coming out and is in a precarious position in terms of price, software, and financial backing. But if it (and Commodore) can survive the next six months, the Amiga could easily be around for 5 to 10 years, long after 520STs are gathering dust on closet shelves.

IN THE QUEUE

Next month will feature round 2 of the 68000 wars. I'll have a number of tables comparing system features and showing the results of various benchmarks. I hope to squeeze in comments on some of the software that is piling up, especially those packages for the 520ST and the Amiga. Until then, I'll see you on the bit stream. ■

Many thanks to the following people for technical information and corrections: Eric Zocher of Silicon Beach Software; Bob Pariseau of Commodore; Neil Harris of Atari; Jez San of Argonaut Software Ltd.; Scott Turner of L5 Computing; Charlie Heath of MicroSmiths; the Amiga crowd on BIX; and the SIG ATARI crowd on CompuServe.

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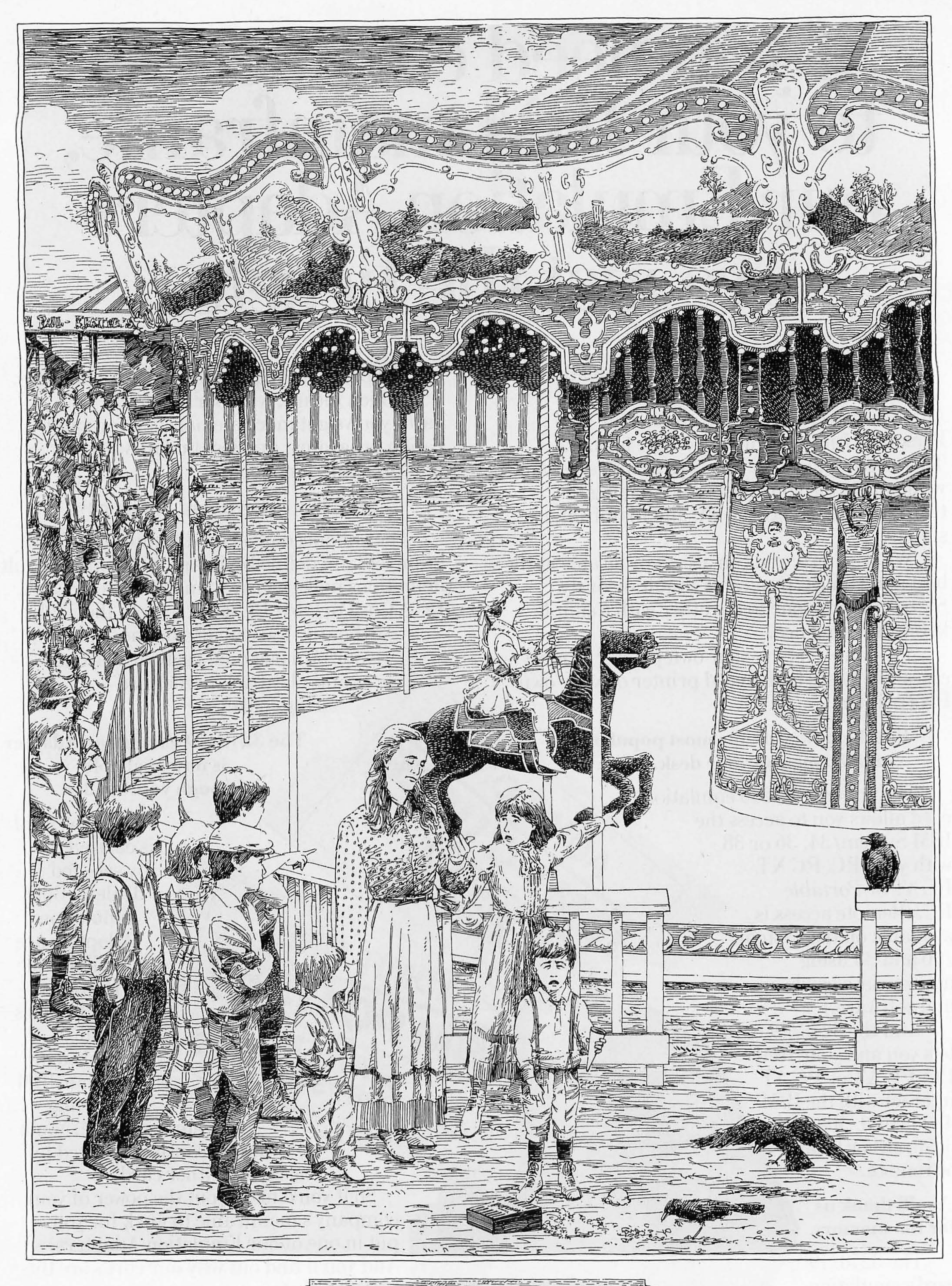
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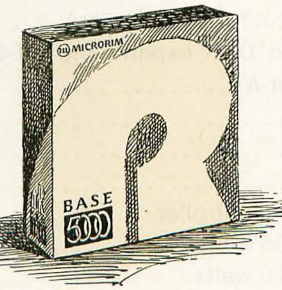
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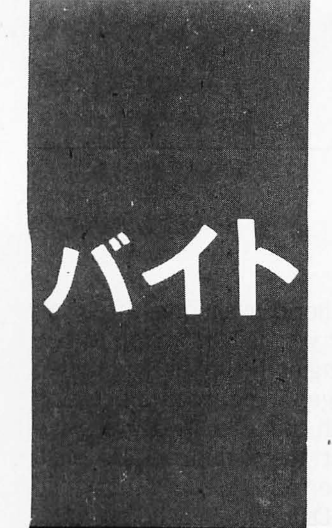


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A New Language and a Laptop

Mind and the Fujitsu FM-16π

BY WILLIAM M. RAIKE

In last month's BYTE Japan I lamented the fact that so few interesting Japanese software products appeared at last October's Software Show. Almost immediately after I wrote that column, one of the local computer journals carried ads for two new software products that I think are worth mentioning. One is an all-Japanese programming language called Mind, and the other is EM/3+, a unified operating environment that supports all three of the most widespread microcomputer operating systems in Japan. This month, I'll talk about Mind.

THE MIND COMPILER

Mind was developed jointly by Rigi Corporation and Microsoftware Associates (which, by the way, is not related to Microsoft Inc.). I haven't been able to do a hands-on evaluation because Mind is available only for NEC personal computers and I own a Fujitsu machine, but I still think it's worth mentioning for several reasons. As far as I can determine, this is the first programming language created in Japan. Although its overall structure seems similar to a kind of structured BASIC, all of the reserved words are written in Japanese kanji characters, and the statement syntax has some patterns that resemble the Japanese language. The language has control, arithmetic, string, graphics, input/output, and file-processing features that seem to be about on a par with recent versions of BASIC in terms of power and flexibility. Mind is compiled rather than interpreted, and programs can be compiled and then linked with separately compiled object libraries using the linkage editor. The language includes a screen editor, and the whole package comes with a fairly extensive collection of source libraries, including graphics, mouse, and communications libraries, and program-maintenance utilities, including a Japanese-language dictionary maintenance utility.

Mind runs under MS-DOS on the NEC PC-9801 series of personal computers (except for the top-of-the-line 80286-based PC-98XA machine). It costs only about $200, a real bargain compared to the cost of most other compilers here, which usually range from $400 to $1500 or more. Those prices are for products that sell for one-fourth to one-half as much in the U.S. (One exception is Turbo Pascal, which is almost as much of a bargain in Japan as it is in the U.S.)

I don't forecast a particularly bright future for Mind, since it seems to offer little that isn't available with other compilers and languages. On the other hand, it could (but probably won't) be used for teaching purposes. The only other language I know of that handles source programs written in Japanese characters (other than for character string constants and comments) is Fifth-86 (a successor to FORTH-86).

For programmers who are familiar with conventional programming languages, Mind will be somewhat slow and cumbersome to use because it takes longer to type Japanese characters than alphanumeric or katakana characters. The screen editor supplied with Mind may help to overcome that drawback; I can't be sure until I see it in action.

RESISTANCE TO WORD PROCESSING

One popular weekly Japanese magazine, *Shukan Bunsho* (October 1985), recently carried an article on whether word processors are a boon or a bane to creative writing. The issues are a little different here than in the U.S. and other Western countries. As I've mentioned before in this column, Japanese typewriters have never been popular or widespread, even in the business world. Japan is now in midleap—jumping straight from handwriting into word processing. Since authors writing in English have long been accustomed to typing their manuscripts, the switch to word processors, while not altogether without trauma, has by and large been welcomed eagerly.

(continued)

William M. Raike, who has a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the United States. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer. He can be contacted c/o BYTE, POB 372, Hancock, NH 03449.

Besides the numerous word-processing programs you can buy for every Japanese personal computer, Japanese consumers now have a choice of dozens of models of dedicated word processors, at prices that start at about $300 for the simplest portable electronic typewriter. These machines offer various levels of sophistication and flexibility in the way they convert phonetic characters (katakana, hiragana, and in some cases the Roman alphabet) into Japanese kanji characters, as well as in how they perform common editing functions like insertion and deletion, cut-and-paste, formatting, and so forth. (Among other things, Japanese can be written either conventionally from left to right or vertically from top to bottom starting at the upper right corner of the page. Some word processors rotate each character 90 degrees and then print them horizontally on a page inserted sideways into the printer.) Different machines offer larger or smaller kanji dictionaries, depending on the price.

A VARIETY OF CONCERNS

Popular acceptance of the new technology has never been in question, but some authors are putting up resistance, claiming they are forgetting how to write some kanji. One author of science fiction, Motoko Arai, told *Shukan Bunsho* that she was embarrassed when she couldn't remember how to write people's names. Shintaro Ishihara, a novelist who's also a politician, writes some of his copy by hand and uses a word processor for the rest; he says his handwriting is terrible but claims the word processor results in a stiff writing style. One poet believes it's impossible to compose poetry at the keyboard, claiming that the concentration involved in calligraphy is essential to his art. On the other hand, novelist Masahiro Mita scorns such attitudes; he feels that the brain's creation is the central issue and that the medium used to capture it is irrelevant. And novelist Ayako Sono uses her word processor all the time but has modified the kanji conversion system to have the machine select particular characters she wants to use.

For foreigners living in Japan, myself included, word processors provide a shortcut to writing Japanese. I'm lazy, and it's much easier to learn to recognize a character when you see it than it is to write it. Most people, Japanese included, can read many more characters than they can write. With a word processor, you type in the phonetic reading of a character, word, or phrase, and then step through a selection of the possible characters with that pronunciation until you find the desired one. In effect, you can write (or type) as soon

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as you can read. I wonder whether U.S. universities are using these machines in Japanese language courses yet.

LAST ON MY BLOCK

I held out for a long time, but last week I finally bought a laptop portable computer. Phil Lemmons, BYTE's editor in chief, has been extolling the virtues of laptop portables for a long time, but I hadn't felt I could justify buying one. And I hadn't really seen one I liked. Well, I overcame my objections and went to Tokyo's Akihabara computer and electronics district to buy a Fujitsu FM-16π. I described this Fujitsu portable briefly in the January BYTE Japan (page 381). My chief complaint then was the awkward design of the space bar on the keyboard: It's split into three sections, and only the middle one works as a space bar; the other two are used to control Japanese word-processing functions. It turned out not to be so hard to get used to after all, and just about everything else about the FM-16π is a delight. The whole machine weighs just over 6 pounds, stands about 2 inches high, and is exactly the size of a sheet of stationery. It uses an internal rechargeable battery plus a separate memory-backup battery and comes with an AC adapter/charger.

Two features convinced me to buy this computer. One was the excellent readability and visibility of the liquid-crystal display. It's an 80- by 25-character (640- by 200-dot) panel, with adjustable contrast, and it has the best readability I've yet seen in this size display—far better, for example, than the Data General/One (which is double the price of the Fujitsu) and as good or better than the Datavue 25. When displaying Japanese characters it can display 11 lines of 40 characters in a very clear 16- by 16-dot font. The other strong incentive was the type of microprocessor used in the FM-16π; it's a CMOS (complementary metal-oxide semiconductor) version of the 8086 (the MBL8086L) running at 5 MHz. The machine runs under CP/M-86, so most of the software I run on my Fujitsu at home can run on the portable, too.

The FM-16π comes in three versions, with either 128K, 288K, or 448K bytes of main memory. I bought the 448K-byte version and use 320K bytes as a RAM (random-access read/write memory) disk. The operating system is contained in a ROM (read-only memory) cartridge, along with some utility software. You can buy either of two cartridges; I bought the one containing a communications utility, a Japanese word processor, a primitive English-language screen editor, and BASIC. The other choice is for Kanji COBOL and the communications utility, which struck me as a particularly useless combination in a laptop computer. One of the built-in utilities is a setup program that lets you do things like allocate memory for the RAM disk, set communication parameters, initialize function keys, set the date and time (there's a built-in calendar/clock), choose an auto-power-on sequence, and choose the interval after which the machine powers itself down when no key has been pressed.

I connected my main computer and the new portable by cable and had no trouble downloading both text or program files at speeds from 300 to 9600 bps (bits per second). Both WordStar and Turbo Pascal work just fine, along with my own all-purpose communications program (it's more convenient than the one supplied in ROM), a spreadsheet program, and other homegrown software. They all fit in the RAM disk (drive A) with plenty of room to spare.

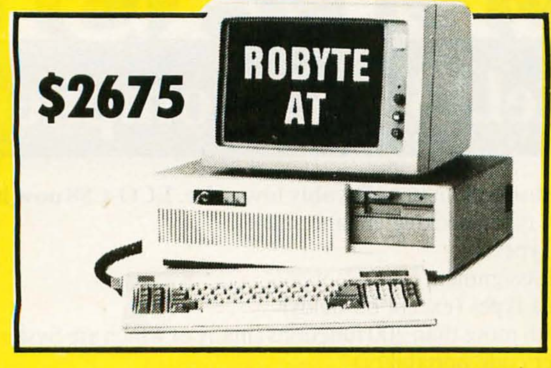
The FM-16π has no built-in floppy-disk drive, although you can buy a separate 3½-inch dual microfloppy-disk drive for about $425. I felt I didn't need it because I'll be able to either upload files to my main computer at home using an RS-232C cable or, if I'm traveling, send them to The Source or elsewhere by telephone. There is a microcassette drive built into the machine, but it's slow (about 200 characters per second), so I doubt I'll use it very often.

Regrettably, while the built-in RS-232C interface works just fine for communications, the FM-16π doesn't have an internal modem, which forces me to use my Epson portable acoustic coupler instead. It's inconvenient, but the lack of a modem is understandable here in Japan, since it's only been a few months since it became feasible to attach a direct-connect modem to phone lines in Japan. In fact, as I write this, there is only one model of 1200-bps full-duplex modem generally available to personal computer owners here, and it's a single-speed device that doesn't work at 300 bps. That situation is certain to change in the very near future, as personal computer communications continues to grow rapidly. Importing the popular U.S. personal computer modems hasn't been a solution, since the Japanese phone system (along with most of the rest of the world) uses different telephone standards (the CCITT, or International Telephone and Telegraph Consultative Committee, standards), with different signaling frequencies, than the Bell 103 and 212A standards. (I did recently discover, though, that many people have found that the American modems work all right at 1200 bps, since the frequencies are apparently close enough.)

COMPUTING EN ROUTE

Since I normally send the copy for this column back to BYTE headquarters in Peterborough, New Hampshire, via The Source, I plan to take my new Fujitsu portable along with me on an upcoming visit to the U.S. Then if BYTE's monthly manuscript deadline falls on the dates that I'm away, I'll be able to file my next column from the nearest telephone. [*Editor's note: Because Bill Raike is traveling, gathering material for upcoming columns,* BYTE *Japan will not appear in the* April *issue of* BYTE *but will reappear in the* May *issue.*] Since Turbo Pascal works so well, I may even get a chance to finish some small software projects. And here at home I can take the computer along with me and work at the local coffee shop. I think the convenience of the FM-16π is worth the investment of $1400 or so. ■

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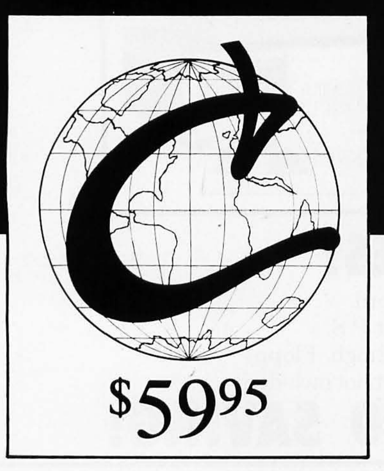
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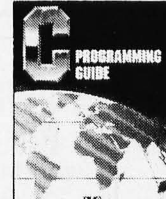
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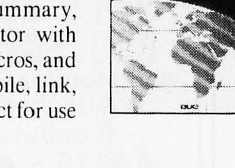
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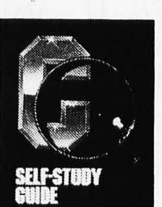
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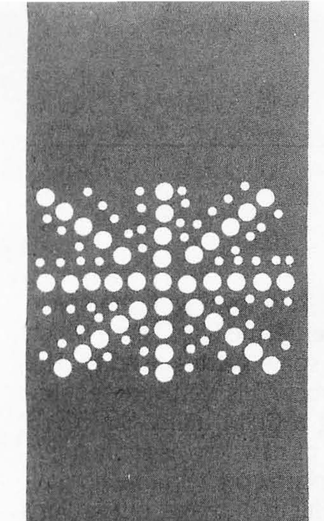
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The Amstrad PCW 8256

A complete word processor and computer that costs less than many electric typewriters

BY DICK POUNTAIN

Progress in the computing business is a more subtle phenomenon than is commonly appreciated. At first glance, it appears to be a steep upward curve: more bits on the data bus, more MIPS (million instructions per second) in the central processor, more memory, more pixels on the screen, more bugs in a bigger operating system—in fact, more of everything.

But in the real world, an apparent step backward can represent progress. Amstrad (Amsoft, Brentwood House, 169 Kings Road, Brentwood, Essex CM 14 4EF, England) recently loaned me its new PCW 8256 (see photo 1), a Z80-based personal computer and word processor that runs the "old" CP/M Plus operating system. So where is the progress in that? In the price. The PCW 8256 retails for £399 in the U.K. This price buys a complete system including a 90- by 32-character green-screen monitor, a near-letter-quality printer, and software. Moreover, the PCW emulates a dedicated word processor with a keyboard full of special keys. For the first time you can buy a completely functional, ready-to-go word-processing system for less than the price of a modest electric typewriter.

The effect on the market here appears to be quite galvanizing. Suddenly, writer friends of mine who have resisted buying a computer for years are asking, "How good is that new Amstrad?" or even, "I'm getting one of those new Amstrads!" It seems as if £500 represents the magic psychological pricing barrier for self-employed professionals, just as £200 has become the barrier for home games players, at least in this country.

I wrote about Amstrad's debut machine, the CPC 464, in fairly positive terms in the January 1985 BYTE U.K. (page 401). Since then, Amstrad boss Alan Sugar has led the company to become the only U.K. personal computer manufacturer to increase profits and stock price amidst the general financial gloom. His formula looks very much like a hardware version of Borland International's road to success—decent products at prices people can afford.

THE HARDWARE

The PCW 8256 is a 4-MHz (megahertz) Z80-based computer with 256K bytes of RAM (random-access read/write memory). Since the Z80 can only directly address 64K bytes, the RAM is bank-switched under the CP/M Plus (sometimes called CP/M 3.0) operating system. This provides for a 61K-byte TPA (transient program area), and all the spare memory (normally more than 100K bytes) is automatically configured as a RAM disk called drive M. The video buffer occupies its own memory bank and can only be accessed by CP/M calls.

Physically, the PCW consists of three units. The monitor unit, which looks very much like a portable television set, sits on a small pedestal and contains the power supply and all the computer components (there is no separate system unit). The detached keyboard plugs into the side of the monitor. A dot-matrix printer takes its power from a 24-volt socket on the back of the monitor, so the whole system can be fed by a single power cord.

In the top right corner of the monitor there is a 3-inch disk drive with a space below it (covered by the maker's name plate) for an optional second drive. Amstrad made the controversial decision some time ago to run with Hitachi's 3-inch microfloppies rather than Sony's 3½-inch standard that Apple, Hewlett-Packard, and Apricot have adopted. When pressed on this point, Amstrad cheerfully claims to have sold enough computers (450,000) to establish its own standard. Right now, though, the decision creates headaches in transporting old CP/M software to the new format.

The 3-inch disk looks quite similar to the now well-known 3½-inch disk, although it is rectangular rather than square. It is fully enclosed in a plastic case with an automat-

(continued)

Dick Pountain is a technical author and software consultant living in London, England. He can be contacted c/o BYTE, POB 372, Hancock, NH 03449.

ically retracting metal shutter to protect the recording surface. Amstrad uses the disks in single-headed drives with 180K bytes on each side of the disk. Each unit is therefore treated as two separate disks—it must be flipped over to access the other side—and each side needs to be formatted independently.

The green-screen monitor is unorthodox in that it can display 90 columns by 32 rows rather than the CP/M (and MS-DOS) standard of 80 columns by 24 rows. This enables you to see a lot more text on screen than usual. A utility program that comes with the system switches it to 80 columns by 24 rows for use with standard CP/M software, while another utility switches from green-on-black to black-on-green display for those (like myself) who prefer it. The monitor emulates a Zenith Z-19 terminal when installing standard CP/M software.

The display's definition is respectable, if not outstanding. It's similar to that of a decent serial terminal. The display character set is also quite good with true descenders and serifs. It uses a full 8-bit character representation allowing 256 symbols; the extras are used as on the IBM Personal Computer to support math symbols and European language characters.

The screen is capable of dot graphics at a resolution of 720 by 248 pixels, and Digital Research's GSX (Graphics System Extension) software is bundled with the machine. In fact, as on previous Amstrad machines, video handling is completely "soft," with no distinction between text and graphics modes; all characters are bit-mapped and could be redefined by a competent system programmer. Despite this, the CP/M applications programmer sees conventional character-based output, as CP/M Plus handles all the underlying trickery.

The keyboard unit has proper keys with sculpted tops and full travel. The feel is not as good as an IBM PC's, but it is much better than the typical home computer. The keys make a hollow "boxy" sound rather like the Macintosh's. I found the spacing cramped, with no gap between the main keyboard and the special-keys pad. The keyboard has no less than six special keys level with the space bar (i.e., below the shift keys), which also takes some getting used to. The whole keyboard is software-redefinable using a CP/M utility SETKEYS and a file of new key assignments.

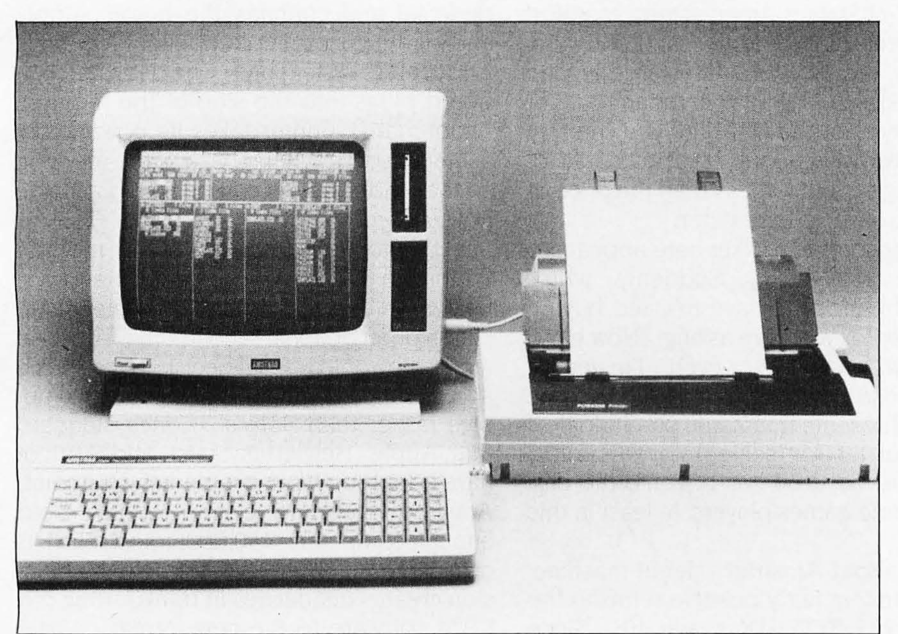


Photo 1: *The new Amstrad PCW 8256 personal computer and word processor. This 256K-byte CP/M Plus computer comes complete with built-in disk drive, keyboard, monitor, letter-quality printer, and word-processing software for a price of £399 inclusive. It also can take a second built-in disk drive.*

The dot-matrix printer has a normal-size 80-column carriage but is very small in the fore-and-aft dimension (around half the depth of an Epson FX-80). The printer comes with a detachable tractor feed and can accept either single sheets or continuous paper.

For me the most heartbreaking feature of this printer is that its high-quality-mode output is as good as anything I can get from my Epson FX-80, which cost me almost as much as a whole PCW system. While not quite daisy-wheel quality, the text is as good as that from a portable electric typewriter, with no dots discernible. High-quality mode gives 960- by 1368-dot resolution at 20 characters per second—faster than cheap daisy-wheel units—while draft mode runs at 90 cps. The printer supports underlining (word or continuous), bold, italic, true subscripts and superscripts, and five font sizes (10, 12, 15, and 17 pitch, and proportionally spaced).

Amstrad has chosen to fully integrate the printer into the hardware and software. The disadvantage is that it is difficult to fit alternative printers. The advantage is that software control of the printer is superb. You can press a dedicated Ptr key at any time to bring up a menu from which you can control all of the printer's functions, including linefeeds, form feeds, and switching from single sheet to continuous paper. The software can even detect when the paper-bail bar is retracted and prompt you to close it. In direct print (i.e., typewriter) mode, you can control the print-head position using the cursor keys; this provides sufficient accuracy so that you are able to fill in complicated forms.

Given the outstanding price, I think that Amstrad's decision to integrate the printer was the right one. The PCW is being sold as a complete writ-

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ing tool, and if you wish to use alternative printers, you probably should buy something else (of course, then you'll end up spending a lot more money).

There are no standard I/O (input/output) ports provided on the basic Amstrad PCW 8256. Amstrad supplies an extension unit that adds both RS-232C serial and Centronics parallel ports.

THE WORD PROCESSOR

As with the original Amstrad CPC 464, software development for the PCW was done by Locomotive Software. In particular, Locomotive put up an extended version of its BASIC (called Mallard BASIC) and the dedicated word-processing program Locoscript.

Locoscript does not run *under* CP/M Plus, but it is a turnkey program that runs straight on the machine, all disk-management activities being performed from within its own menu system. One drawback is that although Locoscript uses the CP/M physical disk format (and can read CP/M directories), it does not use standard CP/M files, so it cannot be used as the system editor.

The initial disk-manager screen displays the directories not only of the floppy and RAM drives but of the separate "groups" on each device. Groups are really CP/M-user partitions, but Locomotive has doctored the software to manage them in a more transparent and intuitive way (more like Macintosh folders). Each device can have up to eight groups on it, and each group contains the same kind of document. The group contains a file defining a template for that group (e.g., letters, memos, reports) and also a file of keyboard macros called "phrases." These utility files are automatically copied to the RAM disk when the system is booted up, although you must deliberately copy your document files to the RAM disk. The directories of all the groups are displayed in vertical columns, and the screen smooth-scrolls sideways to view them all. There is no command line. All file activities are selected by moving a reverse-video cursor block to the filename.

One useful feature is that deleted files are put into limbo; on request you may see a menu of limbo files and call them back if desired. Limbo files are eventually written over as the disk fills up, but this feature provides good insurance against disaster for the neophyte.

The large number of dedicated editing keys on the keyboard simplifies the use of Locoscript. There are keys to move through text by character, word, paragraph, page, or user-defined "unit," and to move to either end of a line. Find and Replace functions have a special key. Cut, Paste,

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and Copy keys let you rearrange the text, and there are two delete keys, Del> and <Del. These make word processing seem rather blissful after years of struggling with nonstandard backspace and delete key actions.

This excellent keyboard is not without its drawbacks for experienced computer users. The escape key is called Exit, the control key is called Alt, and Return and Enter are separate keys. The large Return key performs a typewriter-style carriage return, but you must use the Enter key to execute commands; I'll guarantee that it will take weeks for an experienced computer user's reflexes to adapt. For a first-time user, though, the arrangement is far less mysterious than the curious hodgepodge we have come to accept as the "standard" keyboard. The Exit key is used consistently to terminate operations, while a different key, Can (for cancel), will countermand a mistaken selection.

Commands in Locoscript are selected from pull-down menus activated by function keys F1 through F8. A master menu of the current function-key assignments always appears at the top of the screen. You make menu selections either by entering the initial letter of an item or by moving the cursor, Macintosh-style. When you have gained some familiarity with the commands, you can bypass the menus by hitting the special Select and Deselect keys on either side of the space bar, followed by any recognizable abbreviation for the command. If your abbreviation is too short to be unique (e.g., R could stand for reverse or right-justify), then a shortened menu containing only those options that could fit will be displayed—very smart indeed.

Locoscript has great formatting capabilities. You can introduce new formats, called layouts, at any point in the text, and they take effect on all the text below them until they are overidden by another new layout. A layout includes the margin and tab settings, type pitch and style, and line spacing and justification parameters. You can create a new layout by editing on screen from a pull-down menu; this layout is then assigned a number and stored in memory. Henceforth, you can insert that layout like any other attribute by entering a single code into the text.

If you modify an existing layout, the changes you make automatically take effect everywhere you have used that format; the layouts used are automatically saved with the document. As the cursor enters the zone of a new layout, the layout number is displayed along with other status information at the top of the screen. I found this feature more powerful and easier to use than Microsoft Word's style sheets.

The Show menu controls whether attribute codes, layout ruler lines, and other nontext items are visible. You can have spaces visible as dots, Wangwriter-style, and carriage returns shown as bent arrows. The attribute codes are words rather than cryptic control codes. For example, boldface is indicated by +Bold to select and −Bold to deselect, and a layout might appear as +Layout3. Only underlining is shown as such on the screen.

Locoscript is an inserting editor with wordwrap and it features semiautomatic reformatting. The text is reformatted from the cursor position onward whenever you issue a movement command, so the screen always reflects the current state of the document.

The down side of the story lies in the speed of some of its functions. I ran the BYTE word-processing benchmarks on Locoscript using a standard 23K-byte document with the results shown in table 1.

The times for Document Save and Search are excruciatingly slow, while the times for Document Load and Scroll compare well with WordStar

(continued)



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and other programs. Slow saving is particularly dangerous, as it discourages frequent safety backups. The small difference between RAM drive and floppy timings indicates that the problem lies in the program itself and is not significantly I/O-bound. The PCW's disk system can physically copy a 23K-byte file in 9 seconds. The root cause of the speed problem is the internal representation used to hold text, which involves traversing a linked list, and it is the price you pay for great flexibility of layout and formatting. In practice it means that Locoscript is usable for letters and short documents up to 5K bytes, but not really for books or theses. You could run WordStar as an alternative, but that would be a shame, since Locoscript is so superior in every other way.

SYSTEM SOFTWARE

CP/M Plus is the latest version of the famous 8-bit operating system that many of us grew up with. It fixes most of what was wrong with CP/M 2.2 and adds features that make it feel more like MS-DOS. For example, you no longer need to hit Control-C after changing a disk, you can edit command lines, and the error trapping is almost civilized. CP/M Plus came along just as the IBM PC was transforming the personal computer market, and very few implementations became available. The Amstrad might draw some new attention to CP/M Plus. It is certainly a grown-up operating system, and there are lots of serious programs available that will be able to run under it—just about anything that will run under CP/M 2.2—when the disk-format problem is cracked. I tried out Caxton Software's (10 Bedford St., London W1, England) range of programs, including Cardbox and Brainstorm and the SmartKey keyboard enhancer, and they all ran immediately.

The PCW version of CP/M Plus includes the GSX software and a bunch of programmer tools, including the RMAC macro assembler, SID debugger, XREF cross-referencer, and loads of utilities. You also get Mallard BASIC and Digital Research's Dr. Logo bundled in for your £399. The latter is a first-class implementation of Logo that looks particularly nice on the PCW's high-resolution graphics screen.

Mallard BASIC is business-oriented and differs from earlier Amstrad BASICs that were home-computer-oriented with lots of color and sound commands. (Incidentally, the name Mallard refers to a famous British railway locomotive that held the world speed record.) Mallard is a large superset of MBASIC version 5.2, and its claim to fame lies in a keyed file-management extension called Jetsam. Jetsam provides indexed sequential and random file accesses with file and record locking. You can use the keyed file-management extension to write multiuser database programs, although you can't use it under the single-user CP/M Plus.

To get some impression of its speed —Mallard is, after all, an illustrious name to live up to—I ran the BYTE BASIC benchmarks. The results that I obtained were consistently 25 percent faster than the results of BASICA on an IBM PC.

Table 1: *The results of Locoscript on the* BYTE *word-processing benchmarks using a standard 23K-byte document. The results of WordStar on an* IBM PC *is shown for comparison.*

	LOCOSCRIPT		WORDSTAR
	Floppy Drive	RAM Drive	IBM PC Floppy
Document Load	11 seconds	9 seconds	10 seconds
Document Save	143 seconds	119 seconds	25 seconds
Search	292 seconds	265 seconds	11 seconds
Scroll	65 seconds	62 seconds	41 seconds

CONCLUSION

The Amstrad PCW 8256 is a first-rate CP/M computer, regardless of price. Once you consider the price *and* the included software, it becomes an astonishing bargain. Amstrad has blown the whistle on the pricing policies and the profit margins of other manufacturers.

The PCW should appeal to two completely different groups of users. A large number of first-time users will be attracted by the price and will consider using the PCW as an alternative to an electric typewriter. These first-time users will find Locoscript easy to use and the printer capable of excellent-quality output. Users who are writers intending to use the Amstrad to write books may want to consider an alternative CP/M editor such as WordStar, Perfect Writer, or Final Word.

On the other hand, computer enthusiasts who wish to upgrade from a home computer to a serious machine will find that the PCW can meet almost any of their needs. Also, impoverished scientific and technical users will find the PCW to be a capable machine.

The hardware and CP/M Plus operating system provide plenty of scope for adventurous programming, and you can have the total system for less than the price of upgrading a Commodore 64 to a by-no-means-equivalent specification. Put Turbo Pascal on it and you have serious computing at a sensible price.

As 32-bit processors and multimegabyte memories crowd into the marketplace, it is easy to forget that a machine like the Amstrad has all the computing power that many single users will ever need, plus a software base that includes compilers and applications that were state-of-the-art only a couple of years ago.

Amstrad is keeping quiet about transatlantic plans at present, but by the time this column is published, I wouldn't be surprised to see the PCW announced in the U.S. ■

The SB180 Computer Reasserts 8-Bit Computing In A 16-Bit World

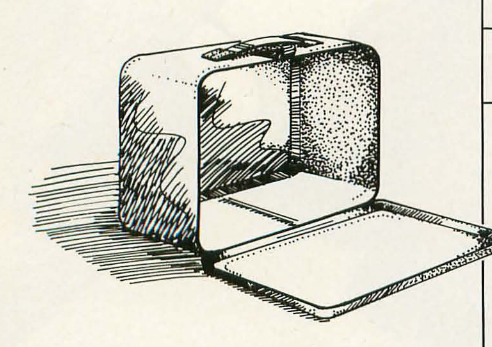
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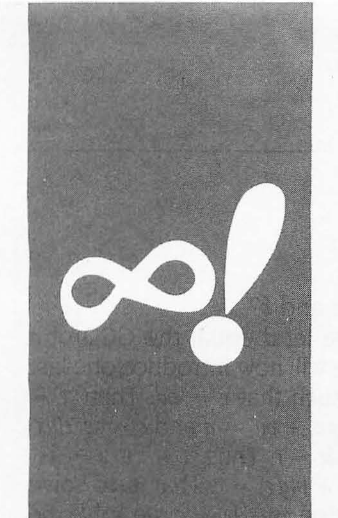
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Diophantine Equations

Finding whole-number solutions to equations

BY ROBERT T. KUROSAKA

A man buys some x's at \$154 each and some y's at \$69 each. If he spends a total of \$5000, how many of each did he buy?

Although this problem appears to be from a first-year algebra text, we find that the techniques required are not usually found in a "mainstream" course in mathematics. The equation $154x + 69y = 5000$ has infinitely many solutions. However, assuming the man bought whole-number quantities, we want *integral* solutions (x,y) for the equation, and now we need a method for solving such equations.

DIOPHANTINE EQUATIONS

Equations of the form $ax + by = c$, for integral a, b, and c and integral solutions (x,y), are called Diophantine equations. No one is certain when or where Diophantus of Alexandria was born. Sources vary from "born about A.D. 50" to "flourished about A.D. 250." He is called "the father of algebra," having promoted algebraic notation and algebraic treatment of mathematical problems. Previously, such work was done by "rhetorical algebra" or geometric proofs.

A variety of methods are available for solving Diophantine equations. One of these is modulo arithmetic, a powerful and fascinating concept that I may explore more closely in a future column.

A very simple method of solving our original problem comes to mind. Since the equation is equivalent to $y = (5000-154x)/69$, we can simply try consecutive values of x (from 1 to 32 only) until we get an integral value for y.

Since we are mathematically inclined, such an inelegant approach may not sit well with us. Rather, we may prefer to look for a method of solution based on general principles of mathematics. What can we say in general about integral solutions for an equation of the form $ax + by = c$?

First, we can readily see under what conditions the equation would have no solution. Consider the greatest common denominator (GCD) of a and b. We will call it d. If d is not a factor of c, the equation will have no integral solutions. Why? Since a/d is, by hypothesis, an integer and b/d is also one, the value $(a/d)x + (b/d)y$ will be an integer if x and y are integers. That is, the integers are *closed* under addition and multiplication. Thus, if c/d is not an integer, either x or y must not be an integer.

DIOPHANTUS MEETS EUCLID

This leads us to Euclid's algorithm, which was the subject of my last column in January (page 397). If we employ Euclid's algorithm to determine the GCD of a and b, we can immediately determine whether there are integer solutions to the Diophantine equation by dividing the GCD into c. But we can use Euclid's algorithm for much more than that. To see how, let us reexamine the algorithm with an eye toward solving Diophantine equations. Figure 1 outlines the way the Euclidean algorithm finds the GCD of 154 and 69. Their GCD is 1, meaning that the two numbers are relatively prime. Now, to begin our examination of the way to solve Diophantine equations, let's modify our original equation to $154x' + 69y' = 1$. That is, we will begin with the case where c is equal to the GCD.

In figure 2, I have rewritten the divisions of figure 1 as equations. In order to find integer values of x' and y' that solve the equation $154x' + 69y' = 1$, all I need to do is substitute $154-2(69)$ for 16 in equations 2 and 3 and $69-4(154-2(69))$ for 5 in equation 3. After collecting terms, I find that $1 = 13(154)-29(69)$. Thus, $x'=13$, $y'=-29$ will satisfy the equation $154x' + 69y' = 1$. We will call $(13,-29)$ the *basic solution* to $154x' + 69y' = 1$. Is it the *only* solution?

Let us write our equation in the general form again: $ax + by = c$. Now, let n be any integer and d be the GCD of a and b. If we add 0 to the left-hand side of the equation, we haven't changed it, so $ax + by + (nab/d-$

(continued)

Robert T. Kurosaka teaches mathematics in the Massachusetts State College system. He invites your correspondence c/o BYTE, POB 372, Hancock, NH 03449.

$nab/d) = c$. Rearranging, $ax + nab/d + by - nab/d = c$. Collecting terms, $a(x + nb/d) + b(y - na/d) = c$. So, once we have the basic solution for x and y, we can generate an infinite number of x's and y's that satisfy the equation by selecting any integer n, multiplying it by b/d, and adding it to the basic solution value of x while we multiply n by a/d and subtract it from the basic solution y. In the case of $154x' + 69y' = 1$, where the basic value of x' is 13, the basic value of y' is -29, and d is 1, any set of numbers (x'',y'') such that $x'' = 13 + n(69)$ and $y'' = -29 - n(154)$ will satisfy the equation.

So far, I have shown two things. First, if c is not a multiple of the GCD of a and b, there is no solution to the Diophantine equation. Second, if c equals the GCD of a and b, the Euclidean algorithm will provide a path for finding all integer solutions of x and y. But what if c is a multiple of the GCD of a and b?

We have let d equal the GCD of a and b. We will now introduce one last letter, e, such that $e = c/d$. Then, $c = de$. Since $ax' + by' = d$ and $c = de$, $e(ax' + by') = de = c$. Thus, $x = x'e$, $y = y'e$, and $a(x'e) + b(y'e) = c$. That is, to solve the equation $ax + by = c$, we solve the equation $ax' + by' = d$, find e such that $e = c/d$, and multiply x' by e and y' by e to find the basic solution of $ax + by = c$. Listing 1 (available for downloading from BYTEnet Listings at (617) 861-9764 or on disk [see page 358]) provides a BASIC program that prompts you to enter the Diophantine equation, checks to make sure that there are integer solutions, and then prints out the basic solutions for x and y, the GCD of a and b, and the parametric equations for obtaining all integer solutions to the Diophantine equation (see figure 3). Other than the Euclidean algorithm that was discussed last time, the program is just a lot of bookkeeping, so I won't bother discussing it here.

To find the GCD of 154 and 69 by the Euclidean algorithm:

1. Divide 154 by 69.

```
       2
69 | 154
     138
     ---
      16
```

2. Divide the divisor by the remainder.

```
       4
16 |  69
      64
     ---
       5
```

3. Repeat step 2 until the remainder is 0.

```
       3
 5 |  16
      15
     ---
       1
```

4. The GCD is the last nonzero remainder, or 1.

```
       5
 1 |   5
       5
     ---
       0
```

Figure 1: *The Euclidean algorithm is illustrated with the numbers 154 and 69.*

Rewrite the divisions of figure 1 as equations:
1. $16 = 154 - 2(69)$
2. $5 = 69 - 4(16)$
3. $1 = 16 - 3(5)$

Substitute $154 - 2(69)$ for 16:
2. $5 = 69 - 4(154 - 2(69))$
3. $1 = 154 - 2(69) - 3(5)$

Substitute $69 - 4(154 - 2(69))$ for 5:
3. $1 = 154 - 2(69) - 3(69 - 4(154 - 2(69)))$

Collect terms to find the basic solution to $154x + 69y = 1$:
3. $1 = 13(154) - 29(69)$

Figure 2: *How to use the Euclidean algorithm to find basic solutions to Diophantine equations.*

LESS IS MORE

What's that? The man in our starting problem didn't buy a negative number of x's or y's? Okay, we're almost done. For $154x + 69y = 5000$, $a = 154$, $b = 69$, $c = 5000$, $d = 1$, $e = 5000$, $x' = 13$, and $y' = -29$. Thus, $x = 13(5000)$, or 65,000, and $y = -29(5000)$, or $-145{,}000$. The parametric equation for all x solutions is $x = 65{,}000 + 69n$; for y, $y = -145{,}000 - 154n$. Since both x and y must be greater than 0, we can write $0 < 65{,}000 + 69n$ for x and $0 < -145{,}000 - 154n$ for y. Thus, $n > -65{,}000/69$ and $n < 145{,}000/(-154)$. Combining and simplifying, $-941.56 > n > -942.03$. Therefore, $n = -942$ and $x = 65{,}000 - 69(942)$, or 2, and $y = -145{,}000 + 154(942)$, or 68. Writing a program to handle inequalities is kind of a pain, so I'll leave that as an exercise for you (don't you wish *you* were a columnist?).

MAIL CALL

I have been receiving a lot of interesting mail recently. Professor Gernot

(continued)

Listing 1: A BASIC *program to solve Diophantine equations.*

```
10 '**************************************************
20 '*              DIOPHANTINE EQUATION SOLVER               *
30 '*                   BY BOB KUROSAKA                       *
40 '**************************************************
50 CLS
60 PRINT "This program solves equations of the form AX + BY = C,"
70 PRINT "where A, B, C, X, and Y are all integer values."
80 PRINT :PRINT "Enter your equation as shown in the general form."
90 PRINT "For example, enter 154X + 69Y = 5000 or 154X-69Y = 5000."
100 PRINT "Do not enter negative coefficients with parentheses."
110 PRINT "That is, do NOT enter 154X + (-69Y) = 5000."
120 PRINT :PRINT "The program will not work properly for the degenerate case"
130 PRINT "where either A or B is 0."
140 PRINT :INPUT "Enter equation";EQUATION$:A$=EQUATION$
150 REM DEFINE A READABLE FUNCTION FOR DISCARDING LEFTMOST
     CHARACTERS.
160 DEF FNDROP.LEFT$(A$)=RIGHT$(A$,LEN(A$)-1)
170 REM PARSING ROUTINE
180 A=VAL(A$)
190 IF A=0 THEN A=1:IF LEFT$(A$,1)="-" THEN A=-1
200 A$=FNDROP.LEFT$(A$)
210 DISCARD$=LEFT$(A$,1)
220 WHILE DISCARD$<>"+" AND DISCARD$<>"-"
230       A$=FNDROP.LEFT$(A$)
240       DISCARD$=LEFT$(A$,1)
250 WEND
260 B=VAL(A$)
270 IF B=0 THEN B=1:IF DISCARD$="-" THEN B=-1
280 WHILE DISCARD$<>"="
290       A$=FNDROP.LEFT$(A$)
300       DISCARD$=LEFT$(A$,1)
310 WEND
320 A$=FNDROP.LEFT$(A$)
330 C=VAL(A$)
340 IF A<>INT(A) OR B<>INT(B) OR C<>INT(C) THEN PRINT "NOT A
                                  DIOPHANTINE EQUATION":GOTO 760
350 REM END OF PARSING ROUTINE
360 REM EUCLIDEAN ALGORITHM FOR FINDING GCD.
370 REM FIRST, INITIALIZE THE TERMS FOR THE ALGORITHM
380 IF ABS(A)>=ABS(B) THEN DIVIDEND=A:DIVISOR=B
390 IF ABS(A)<ABS(B) THEN DIVISOR=A:DIVIDEND=B:SWAP.XY$="YES"
400 REM USE 'FIX' INSTEAD OF 'INT' TO TRUNCATE RATHER THAN ROUND
     NEGATIVE #s.
410 QUOTIENT=FIX(DIVIDEND/DIVISOR)
420 REMAINDER=DIVIDEND-DIVISOR*QUOTIENT
430 REM X1=ONGOING COUNT OF X', Y1=ONGOING COUNT OF Y'. YOU
     CAN KEEP TRACK OF ALL ONGOING COUNTS BY USING ONLY THE
     PREVIOUS TWO VALUES FOR X' AND Y', SO WE NEED ONLY X1, X2, X3,
     AND Y1, Y2, Y3.
440 X1=1:Y1=-QUOTIENT
450 REM IF EITHER A OR B IS AN EVEN MULTIPLE OF THE OTHER, THEN
     EITHER X' OR Y' WILL EQUAL 1 WHILE THE OTHER EQUALS 0.
460 IF REMAINDER=0 THEN X2=0:Y2=1:GOTO 620
470 DIVIDEND=DIVISOR:DIVISOR=REMAINDER
480 QUOTIENT=FIX(DIVIDEND/DIVISOR)
490 REMAINDER=DIVIDEND-DIVISOR*QUOTIENT
500 X2=-QUOTIENT*X1:Y2=1-QUOTIENT*Y1
510 REM IF A GCD IS FOUND ON THE SECOND ITERATION OF THE
         EUCLIDEAN ALGORITHM, THEN X'=X1, Y'=Y1. IN ALL
         SUBSEQUENT CASES, X'=X2, Y'=Y2.
520 IF REMAINDER=0 THEN X2=X1:Y2=Y1:GOTO 620
```

(continued)

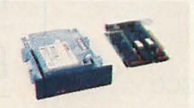
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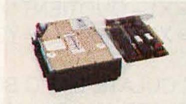
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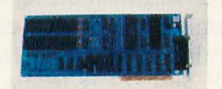
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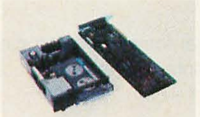
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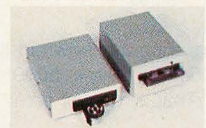
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Inquiry 232

```
530 REM THE FIRST TWO ITERATIONS ARE THE ONLY ONES THAT DO NOT
        FOLLOW THE PATTERN: X(N)=X(N-2)-QUOTIENT*X(N-1),
        Y(N)=Y(N-2)-QUOTIENT*Y(N-1).
540 WHILE REMAINDER< >0
550     DIVIDEND=DIVISOR:DIVISOR=REMAINDER
560     QUOTIENT=FIX(DIVIDEND/DIVISOR)
570     REMAINDER=DIVIDEND-DIVISOR*QUOTIENT
580     IF REMAINDER=0 THEN 610
590     X3=X1-QUOTIENT*X2:Y3=Y1-QUOTIENT*Y2
600     X1=X2:X2=X3:Y1=Y2:Y2=Y3
610 WEND
620 REM CALCULATE BASIC SOLUTION FOR AX + BY = C FROM GCD
        RESULTS, WHICH HAVE PROVIDED AX' + BY' = D BASIC
        SOLUTION.
630 D=DIVISOR:E=C/D
640 IF C/D< >INT(C/D) THEN PRINT "NO INTEGER SOLUTIONS.":GOTO 760
650 IF SWAP.XY$="YES" THEN SWAP X2,Y2
660 PRINT "The basic solution to the Diophantine equation,"
670 PRINT EQUATION$;"    is:"
680 PRINT "X = ";X2*E:PRINT "Y = ";Y2*E
690 PRINT "The GCD of ";A;" and ";B;" is:";ABS(D)
700 PRINT "The parametric equations for all integer answers is:"
710 PRINT "X = ";X2*E;:IF B/D>0 THEN PRINT " +";
720 PRINT B/D;"N,    and"
730 PRINT "Y = ";Y2*E;:IF A/D<0 THEN PRINT " +"; ELSE PRINT " -";
740 PRINT ABS(A/D);"N"
750 PRINT "for all integer values N."
760 END
```

This program solves equations of the form $ax + by = c$, where a, b, c, x, and y are all integer values.

Enter your equation as shown in the general form. For example, enter $154x + 69y = 5000$ or $154x - 69y = 5000$. Do not enter negative coefficients with parentheses. That is, do *not* enter $154x + (-69y) = 5000$.

The program will not work properly for the degenerate case where either a or b is 0.

Enter equation? $74x+85y=1$
The basic solution to the Diophantine equation,
$74x+85y=1$ is
$x = -31$
$y = 27$
The GCD of 74 and 85 is 1.
The parametric equations for all integer answers are
$x = -31 + 85n$ and
$y = 27 - 74n$
for all integer values n.

Figure 3: A *screen dump of the program in listing 1 solving a Diophantine equation.*

Metze of the University of Illinois at Urbana-Champaign stunned me with this concept: Use ϕ, the Golden Mean, as a number base. (I will wait while you catch your breath.)

The system uses the digits 0 and 1 and is based on the identity $\phi^2 = \phi + 1$. In order to get a feel for what he has to say, we should take a brief excursion into another way of using the Euclidean algorithm: representing numbers as continued fractions. Figure 4a shows how to represent 154/69 as a continued fraction. You

One interesting letter suggested using the Golden Mean as a number base by employing the identity $\phi^2 = \phi + 1$.

just collect all the quotients from the Euclidean algorithm (2, 4, 3, 5) and stack them as shown in the figure. Any rational number can be expressed as a finite continued fraction. Now, $\phi = (1 + \sqrt{5})/2$, and $\sqrt{5}$ is irrational. Its continued fraction will be infinite but regular (see figure 4b). When we "add" the continued fractions for 1/2 and $\sqrt{5}/2$, we get the continued fraction for ϕ in figure 4c. ϕ turns out to be the simplest continued fraction, $(\overline{1})$. Back to Professor Metze.

The identity $\phi^2=\phi+1$ means that "100" = "011" in the ϕ-nary system, and these two patterns can be interchanged anywhere in a ϕ-nary number. For example, 10011 = 10100 (the rightmost "011" becomes "100"), and 1110 = 10010 (the leftmost "011" becomes "100"). That is, the final representation need not contain consecutive 1s.

You may want to try to construct an addition table in base ϕ, but some mental agility is required. Our first snag is "1 + 1." How do we "carry" in this system? Since 1 = 1.00 = 0.11 (remember the pattern switch?), we can proceed: 1 + 1 = 1.00 + 1.00 = 1.00 + 0.11 = 1.11, which can be rewritten as 10.01, and we have found "2"! You may wish to verify that 10.01 = 2, that is, that $\phi+\phi^{-2}=2$. Similarly, we find "3" with 10.01 + 1.00 = 11.01, = 100.01, and so on. The representations grow rapidly in both directions.

There was a large and enthusiastic response to the "π, e, and All That"

(continued)

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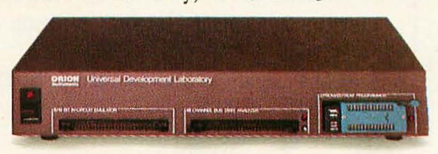
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Inquiry 258

column (September 1985, page 409). Many readers requested the derivation of the complete permutations formula. Everyone found or already knew of the hiding place of ϕ in the Fibonacci sequence. Others demanded to know why $e^{i\pi} = -1$.

All who were interested in the approximation of π by the Buffon experiment agreed that my program was dishonest for its inclusion of $\pi/2$ in the program itself. Several readers offered alternative methods that avoided using π.

An impressive method for doing the Buffon experiment without using π involves calculating slopes for random pairs of points.

(a)

The quotients of the Euclidean algorithm for the GCD of 154 and 69 are (2,4,3,5). The continued fractional representation of 154/69 is

$$154/69 = 2 + \cfrac{1}{4 + \cfrac{1}{3 + \cfrac{1}{5}}}$$

(b)

The continued fractional representation of $\sqrt{5}$ is

$$\sqrt{5} = 2 + \cfrac{1}{4 + \cfrac{1}{4 + \cfrac{1}{\dots}}}$$

(c)

The continued fractional representation of $\phi = (1 + \sqrt{5})/2$ is

$$\phi = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{\dots}}}$$

Figure 4: *The way of representing numbers as continuing fractions. (a) 154/69 as a continuing fraction; (b) the infinite continuing fraction for $\sqrt{5}$; (c) the simplest infinite continuing fraction, ϕ.*

Listing 2: *Donald Higgins's program to approximate π by the potshot method.*

```
5 REM Program to approximate pi by Donald S. Higgins, St. Petersburg, FL.
10 INPUT "TRIALS"; N
20 FOR I= 1 TO N
30      X = RND(0)
40      Y= RND(0)
50      IF X*X+Y*Y < 1 THEN C = C + 1
60 NEXT I
70 PRINT "ESTIMATE OF PI = "; 4*C/N
```

The most popular suggestion was the potshot method. There is a circular target inscribed on a square board. Random shots are fired at the board, and, assuming all shots hit the board, we count the number of shots that strike inside the circle. For longer and longer volleys, the ratio of the number of strikes inside the circle to the number of shots fired approaches $\pi/4$. Donald S. Higgins of St. Petersburg, Florida, offered the miniprogram in listing 2.

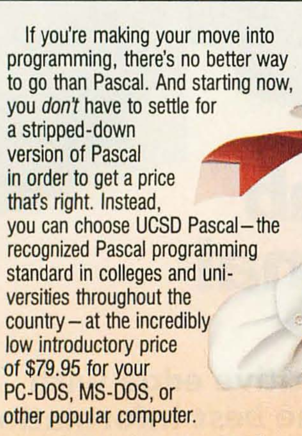
It turns out that I was lucky not to have adopted his method because the April 1985 *Scientific American* described it (among other simulations) in the "Computer Recreations" column by A. K. Dewdney.

Ellis Golub of Bryn Mawr, Pennsylvania, offered an impressive method. Select four random decimals and use them to form two random points: ($x1,y1$) and ($x2,y2$). Consider the slope of the line through these two points: SLOPE = ($y2 - y1$)/($x2 - x1$). Then let PROJ = .25/SQR (SLOPE^2+1), which is equivalent to my .25*COS(ANGLE) but completely eliminates the use of trig functions and any mention of π. He also had a 25 percent reduction in running time.

In the next column, I will examine Pellian equations, which are of the form $x^2 - ny^2 = 1$, where n is a nonsquare integer and the solutions (x,y) are integral. Until then, keep those cards and letters coming. ■

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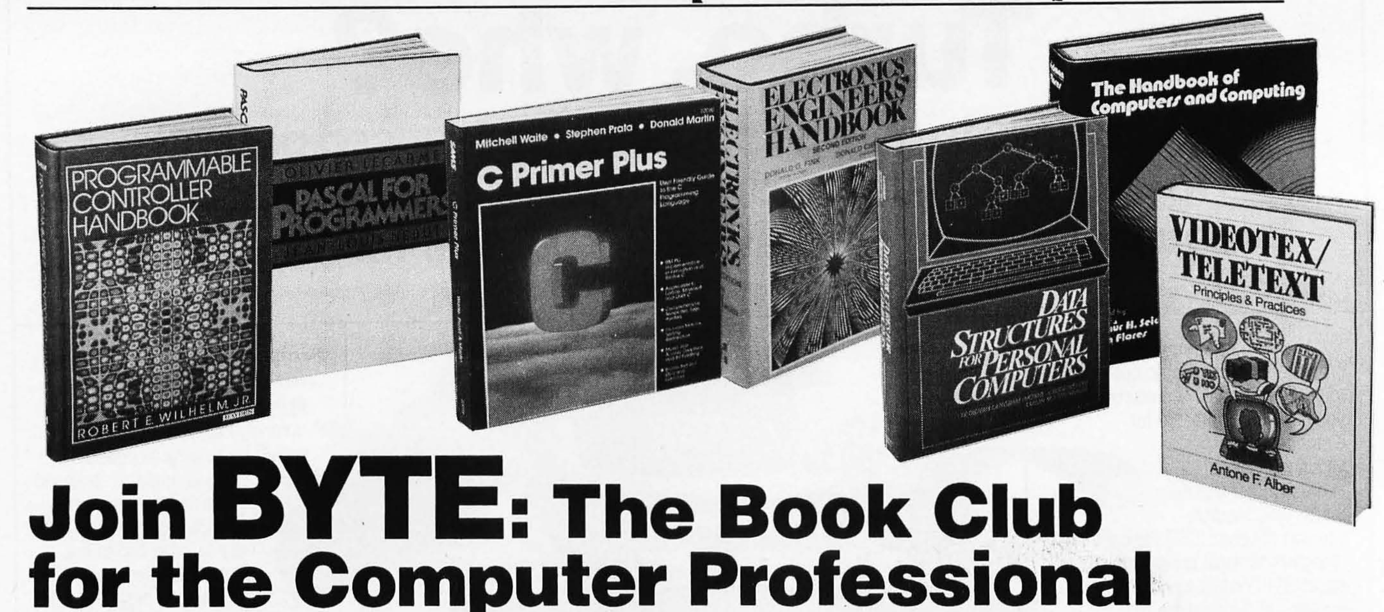
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SB180 QUESTIONS

Dear Steve,

After reading about the SB180 in the September 1985 BYTE, I have a couple of questions and observations.

Last year, I sold my old computer and a TeleVideo 925 terminal, and I now have an IBM PC. I did some of the beta testing for the Trump Card, and it seems that the ideas behind it and the SB180 aren't too remote from one another. Would it be possible to somehow use the IBM's power supply and disk drives for the SB180 as well as interfacing the IBM PC to act as a terminal?

I'm a big fan of the Oasis operating system, and I still help maintain a friend's computer using Oasis. If I were to return to 8 bits, I would like to take advantage of all the experience I've had using Oasis. Do you know if it can be implemented on the SB180? A 512K-byte memory disk (or maybe even a 10-megabyte hard disk) would be a great addition to such a system.

Now for the observations: One thing that really appeals to me is the possibility of the SB180's portability. However, I keep running into the same problem—no one makes a readable screen for a portable. Mostly, it seems that this is because people want a battery-operated system. Thus, the portable must rely on the limited power that batteries can supply. I am rarely far from a plug and would much prefer a system that has a highly readable screen. Any thoughts on this?

MICHAEL CASEY
Highland Park, IL

You can certainly use the IBM PC's case, power supply, and disk drives with the SB180. The SB180 draws little current, so it wouldn't be much of a drain on the PC's power supply. At least one of the disk drives must be a double-sided double-density unit in order to boot up the Z-System; otherwise, the drives will be fine. It would even be possible to have a dual-processor system and use the PC as a terminal into the SB180. You could mount four half-height drives in the PC: two for use by the PC itself, and two for use by the SB180. When you wished to use the SB180, you could boot up a terminal-emulation program (Crosstalk, PC-Talk), which would actually be connected to the console input of the SB180. Then, Z-System would be loaded from the other two drives.

You should have little trouble implementing such a system since no major modifications are needed to either computer. Most of the work would be in making mechanical/electrical connections, so a minimum of technical know-how would be required. If you do attempt this project, please send me a write-up.

As far as I know, no one has brought up Oasis on the SB180 yet. The BIOS source code that comes with the software for the SB180 would be invaluable. If you have ever ported Oasis to a different machine, getting it on the SB180 should be no different. I agree that a hard disk is a near necessity. In December 1985, I presented a combination 300/1200-bps modem and SCSI hard-disk expansion board for the SB180. I also plan a more sophisticated presentation in May 1986.

As soon as I find an economical portable display, I'll be looking for a way to incorporate it into an article—perhaps with a revision of my Term-Mite board. —Steve

DVORAK KEYBOARD

Dear Steve,

I have a question about your Term-Mite design (January and February 1984). I am particularly interested in implementing a Dvorak simplified keyboard, and the Term-Mite offers some possibilities in that direction. According to your description of the keyboard-scanning routine, it would be necessary only to substitute the desired ASCII values in the lookup table that the routine uses to assign values to the keystrokes. Where is that table located?

R. F. WHITE
Ft. Worth, TX

You are correct about changing the keyboard-scanning table to implement a Dvorak keyboard. The table is in the EPROM, beginning at location 278 hexadecimal. The current table contains the ASCII code for each key in 1 byte. You need only substitute the bytes in this table for the new key encodings for the Dvorak layout. See table 1.

Code resumes at location 2CF hexadecimal. When you change the EPROM code, you must set switch sw1, position 6, closed to enable the EPROM. One problem may be that the punctuation above the numbers will not be separately controlled by these changes, because they are generated from the character codes themselves. The source code for the Term-Mite is available for $20 from

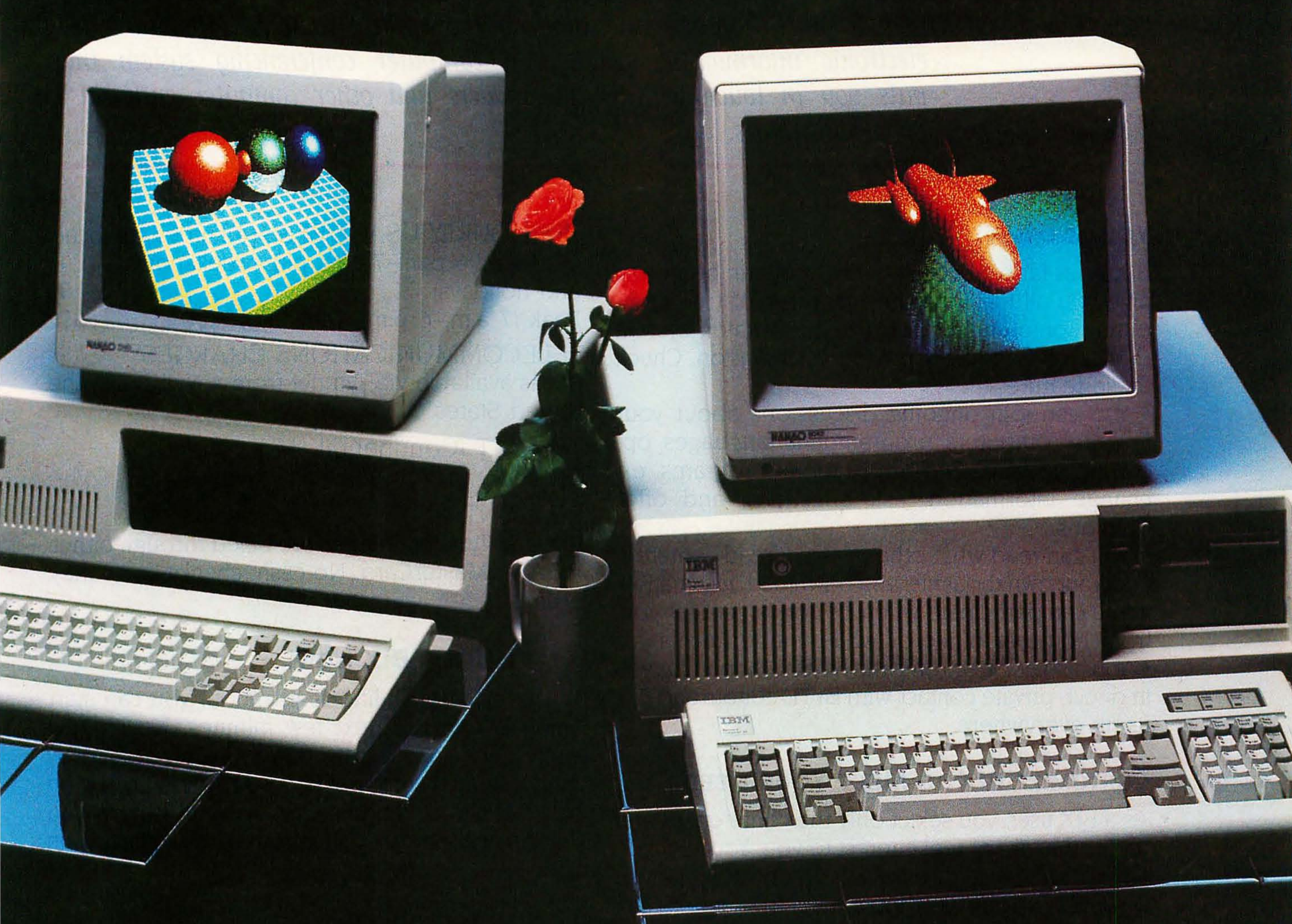
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To understand it, get "NS455-Series Terminal Management Processor (TMP)" from National Semiconductor. It has a complete description of the chip and a description of the instruction set of the processor.—Steve ■

Table 1: *The new key codes needed for the Dvorak layout.*

278	esc	ctl/s	ctl/l	LF	VT	null	tab	ctl/n
280	BS	ctl/p	ctl/q	ctl/r	ctl/o	7	8	9
288	2	3	4	6	5	7	1	8
290	\	9	-	0	˜	null	null	null
298	W	E	R	Y	T	U	Q	I
2A0	underbar	O	[	P	]	4	5	6
2A8	S	D	F	H	G	J	A	K
2B0	CR	L	:	;	\	1	2	3
2B8	X	C	V	N	B	M	Z	,
2C0	rubout	null	/	.	null	0	null	.
2C8	null	null	null	null	null	null	space	

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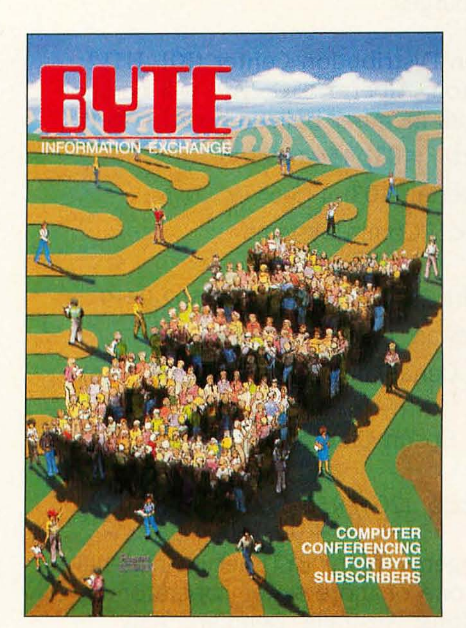
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(continued from page 32)

ANOTHER SOFTWARE-ONLY SPEECH SYNTHESIZER

I am writing about a letter from Gary W. Odom of Melborne, Florida, entitled "Long Live the Macintosh" (Letters, October 1985, page 30). In his letter he said, "The four-voice sound generator produces astounding computer music, so good that the Macintosh has the only software-only speech synthesizer available on a computer of any size."

I would like to correct his error. I have an Atari 400 and 800XL, and both have four-voice music with the ability to synthesize speech using S.A.M. by Don't Ask Software. S.A.M. produces speech and allows the user to vary both pitch and speed.

I may be overreacting, but it bothers me when someone makes an all-encompassing statement, as in Mr. Odom's letter. Some degree of responsibility must be assumed by anyone making such a statement. Without this responsibility, a letter becomes pure conjecture and opinion.

ROGER N. ASCH
Fishkill, NY

VLSI: NOT VERY

So many of your articles use the acronym VLSI (very-large-scale integration) when indeed LSI would be the correct term. For instance, in the January issue, "The Acorn RISC Machine" by Dick Pountain (page 387) stated that the ARM chip contains 25,000 transistors. Surprise! This meager amount of devices constitutes LSI, not VLSI, and there is a vast difference in complexity.

Here is a table for your reference showing the relationship between level of integration and device count.

Device Count	Integration
1,000,000	ULSI
100,000	VLSI
10,000	LSI
1000	MSI
100	SSI

Examples of LSI are the 68000 microprocessor and 16K dynamic RAMs. Examples of VLSI are the 80286 microprocessor and 64K dynamic RAMs. Please try to apply some standard meaning for integration acronyms.

DANIEL J. PAYNE
Santa Cruz, CA

WHO NEEDS INTEGRATED PROGRAMS?

Jerry Pournelle's comments in the 10th anniversary issue (Computing at Chaos Manor, September 1985, page 347) just confirmed my feeling that integration is becoming a much less important term in computerdom. In fact, I think the integrated products have reached their zenith and it will all be downhill, AppleWorks notwithstanding.

As a journalist and a computer user since 1980, I've been using Apple PIE for word processing and pfs:File and dBASE II for database applications. Until recently, I had no use for a spreadsheet. When I did start using a sheet, I went to my own library, shook the dust off an early version of VisiCalc, and starting using it.

The reason I haven't changed my main programs is comfort. I know all four programs backward and forward, well enough

(continued)

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to tutor other people in their use. I have no desire for an "integrated" program. The degree of program improvement and data interchangeability simply doesn't merit tackling a new learning curve.

Furthermore, until I needed a spreadsheet, none of the integrated programs on the market would have met my needs. However, I will admit to looking at AppleWorks very closely, since I have need for all of its functions. Throw in the upcoming Jeeves and the system appeals to me greatly.

As a sometime consultant, I've also had occasion to computerize a friend, an internationally known sculpture. His son left him a Zenith while he went gallivanting off to other parts of the world, and he's decided to get more serious about computers.

He asked me about Symphony, the supposed king of integration.

I asked him, "Have any complaints about WordStar?" He shook his head.

"Got any major problems with dBASE II?" Another shake of the head.

"Multiplan does just about everything else you want, right?" An affirmative shake of the head.

"In other words, you feel comfortable with what you're using."

My friend laughed and abandoned plans to become integrated.

I think the main problem with integrated programs is that they are *too* powerful. I cheerfully admit that my "regulars" don't have as much power as I would like. But they fill the bill 95 percent of the time.

As a result, I don't get my computer loaded up with RAM-consuming modules that slow down the modules that I do want.

Something like Switcher for the Macintosh is an important idea. It allows the user to cobble together the integrated system of his or her choice. Two years ago, I would have put PIE together with pfs:File (if there had been an Apple II analogy of Switcher back then) and would have been as happy as a clam. Then, when I found the need for a spreadsheet, I would have reconstructed my system to include VisiCalc.

Notice I've never found a need for a graphing program, and I am happy I'm not wasting RAM to have one at the press of a button.

I don't think I stand out all that much. Very few business users actually end up using all the various modules of integrated programs. Many businessmen make use of spreadsheet and graphing programs, with occasional access to the database. The word processing is left to secretaries, who rarely have any reason to do spreadsheeting.

That is not an all-encompassing statement. Many businessmen, and many secretaries, do use all the various modules. But many don't. And of the many that do, how many can't afford the time to quit a program and load another one, instead of going from module to module?

No, if I were a programmer right now, I'd be working on Switcher-like programs, the kind of Chinese-menu programs that will allow people to do their own integration.

GARY MACPHERSON MUGFORD
Bramalea, Ontario, Canada ■

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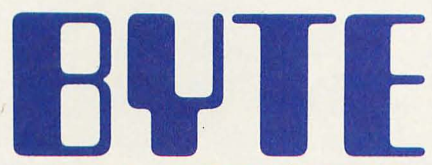
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AMIGA

Topics this month include notes on compiling programs for the Amiga, recovery of inadvertently zapped disks, and posting source code to the BIX network. The Software Bugs and Fixes section contains a workaround for a disk font system bug. Users of both Amigas and Macintoshes compare notes on disks, windows, and menus.

Alastair J. W. Mayer, author of BIX's CoSy software, presents a comparison of precision versus resolution with regard to computer graphics systems, there is discussion of Electronic Arts' IFF graphics protocol for message exchange, and Bob Pariseau of Amiga reveals the secret of Amiga's bouncing-ball demo.

COMPILING AMIGA PROGRAMS

amiga/main #733, from crunch [John Draper]

The Amiga BBS in Los Gatos has a demo program called "toydemo.c" which is supposed to use the Amiga's speech system. Unfortunately, I cannot get it to compile. Has anyone else had the same problem? Would anyone from Amiga care to comment on it? The program was written by Dave Lucas in Los Gatos. I think it is supposed to show a person talking with lips moving and speaking.

I sure would prefer the programs on the Amiga that support BBSs to compile on the native compiler without modification. I get the "system error" request. The program is rather long. I tried for several days to break it up into two smaller pieces. Then I broke off the gadget, menu, and other structure definitions into a separate header file.

I was very frustrated because I was curious what the program looks like.

amiga/main #740, from mikez [Michael Zarembski]: a comment to 733

If you are referring to the speechtoy.demo.c, I had the same problems till I reset the stack to 30,000 (by doing a "stack 30000"), and then it compiled just fine. It appears that phase 1 of the Lattice C compiler was overwriting the system stack and the system would go out to lunch (Lattice claims V3.03 will do stack checking).

The program is neat for checking out the speech variables interactively using the mouse.

amiga/main #743, from crunch: a comment to 740

Please tell me where I'm supposed to type the stack 30000? Do I type it into CLI or "INCLUDE" it in the source?

amiga/main #748, from mikez: a comment to 743

At the CLI prompt (1 >), type "stack 30000," or you can do what I did and put the stack command in s/startup-sequence so that it will automagically reset the stack for me.

amiga/tutorial #208, from pariseau [Bob Pariseau, Commodore-Amiga]

TITLE: Up That Stack!
There have been several reports from folks saying that they get system crashes or other strange results when they try to compile or link large programs on the Amiga.

These failures are *almost always* due to insufficient stack space for the compiler. The default stack setting in a new CLI is 4000. As a matter of course, I bump mine up to 20,000 when I'm doing compiling.

If you have modified your s/startup-sequence file to leave your CLI around when you boot, I would recommend that you put the command stack 20000 in that file as well.

If you get to your CLI from the Workbench icon, either remember to reset the stack when you start or, for those of us with short memories, put the stack 20000 command in the front of your Make script. That way you're assured of having a sufficiently large stack whenever you compile. Note that the commands are not "cumulative" in any sense; thus you can issue and reissue stack commands to your heart's content.

In particularly complicated programs, a stack of 20,000 may not even be enough. If your system crashes while compiling, *double the size of your stack*.

USING A PASCAL COMPILER WITH A SINGLE DISK DRIVE

amiga/softw.devlpmt #476, from jmeyer [Jim Meyer]

TITLE: Pascal and Single Drive?
Some of the members of my users group, who don't yet access the BBSs, can't get their Pascal to work with a single-drive system. The Pascal manual seems to indicate that a second drive is required. Is it possible to simply create a RAM disk and assign it to df1? (I'd give it a shot, but I'm W.P.—Without Pascal.)

amiga/softw.devlpmt #477, from jdow [Joanne Dow]: a comment to 476

You might have to use two disks with Pascal compiler and INCLUDE files on one disk and the linker on the other. If the Pascal is anything like the C, you will find you can shove some of the files off into the RAM:. (Simply "copy source file to RAM:".)

The linker seems to take enough memory that it will not run for me if there is very much else working in the 512K RAM I have. Hence, it might have to be on its own disk with the libraries.

TRASHED DISK RECOVERY

amiga/tech.talk #152, from sdb [Scott Ballantyne]

TITLE: Help with Garbaged Disks!
I have had a lot of fun reading the messages here, and I'm sorry to leave this one as my first, but, HELP!

I made a small change to my start-up script, and BOOM!, the disk became unreadable when I wrote it out.

Has anyone figured out the disk format and DiskEd enough to help me recover it?

P.S.: Do I have the honor of being the first to trash a disk on the Amiga?

amiga/tech.talk #155, from cheath [Charlie Heath, MicroSmiths]: a comment to 152

You're not the first, unfortunately.

It is possible to recover zapped disks with a tool called DiskEd, which is included in the developer's kit. It is not fun.

SOFTWARE BUGS AND FIXES

amiga/softw.devlpmt #473, from pariseau

TITLE: Disk Font System Bug!
There is a bug in the V1.0 and V1.1 diskfont.library code that can cause the system to crash when memory gets low. A workaround is presented below.

Disk-based system resources such as fonts and device drivers are

(continued)

brought into memory when they are first opened. They remain in memory thereafter until some task asks for more memory than is available in the system "Free Memory Pool." At that point the Exec function AllocMem( ) "expunges" (removes from memory) any resources that currently have zero openers. This design means that resources tend to hang around in memory so that if they are frequently opened and closed there is no time lost reloading them from the disk.

Many applications periodically use the trick of attempting to "AllocMem( )" more memory than can possibly be in the system, to flush any unused resources from memory. Note that if AllocMem( ) finds any resources to expunge, then the number returned by AvailMem( ) *after* the call to AllocMem( ) will be [larger] than before the call (presuming, of course, that the AllocMem( ) does not, in fact, return a newly allocated chunk of memory to you).

The bug is that when a disk-based font is expunged from memory, the expunge code in diskfont.library does not properly remove the font descriptor from the list of fonts known to be in memory. Thereafter, whenever a font is looked up, there is a chance that the system will crash since the font node now points at memory that has been returned to the system "Free Pool."

The workaround involves manually removing the font from the font list before you close it. The workaround, as presented, provides maximum protection for the system at the expense of possibly having multiple copies of the font temporarily exist in memory together. If you know that *all* font users in the system are using the workaround, then only the last closer of the font need do the Remove( ) function.

Note that version 1.1 of Notepad (for instance) does *not* implement this workaround.

The workaround for the diskfont.library bug is, whenever closing a font:

1. Forbid( );
2. Check the font flags to see if it is a disk font.
3. *If a disk font,* check that this font is in a list by ensuring that the predecessor's and successor's nodes point to it.
4. If the font is in a list, "Remove(0, font)" it.
5. Permit( );
6. CloseFont( );

Note that the first argument to Remove( ), the 0, is a dummy argument present for historical purposes. The TextFont structure is described in the include file text.h (or text.i if you speak assembly). Note that the "Accessors" field contains the opener count for a font.

If you are not concerned with reclaiming the memory space taken up by your unused fonts, it is sufficient, as an alternate workaround, simply to never close your fonts. This will ensure that AllocMem( ) never tries to expunge the font.

Note that this would keep the font from *ever* going away—even after your program terminates. If Notepad, or another program, has opened and closed disk fonts prior to the running of your program, the font list has the potential of being messed up the next time AllocMem( ) goes to expunge resources.

If such an expunge has already occurred, there is no recovery other than to reboot the system. On the other hand, if an expunge has *not* yet occurred, you can protect yourself by emptying the font list before you first trigger an expunge. To empty the font list, traverse it starting from the TextFonts pointer found in the structure GfxBase. Do a Remove( ) on each disk-based font in the list.

(*Warning!* Only Remove( ) disk-based fonts.) The elements of the list are structures of the type TextFont. Note that you *must* do this cleanup prior to *triggering your first* expunge (i.e., before calling AllocMem( ) with a large value). This cleanup should be done while tasking is disabled (i.e., between a Forbid( ) and a Permit( )).

This bug will be fixed in the V1.2 system software. Any application implementing the above workaround will continue to work under the new system software.

POSTING SOURCE CODE ON BIX

amiga/main #704, from crunch

TITLE: Amiga Source

I have some Amiga source code to post on BIX. It is quite long and was written by a friend of mine who asked me to post it. Would anyone please BIX-mail me instructions on what procedures I need to follow to post it?

amiga/main #707, from jdow:
a comment to 704

If you are uploading to this conference (source less than perhaps 50K bytes to 70K bytes), there is a reasonably successful procedure. For longer files, find the Amiga section in the Listings conference and upload there.

1. If logged on through Tymnet, make sure flow control (XON/XOFF) is disabled (i.e., do not send a Ctrl-X and/or Ctrl-R during log-in). Set up your terminal program to generate a local echo of your typing; then set Tymnet to half-duplex by typing a backspace during the typing of the "byteneti" prompt.
2. To set up for XMODEM transfer mode, type "opt up xmodem down xmodem q."
3. Have a clear scratchpad—uploading clears out what is currently stored in your scratchpad to start out fresh. This way you won't be surprised upon finding something valuable was deleted from your scratchpad area.
4. At any "R:" prompt type "UP." You'll get several lines of "UMODEM ready for upload" messages.
5. When the messages stop, proceed to engage your XMODEM program and send the file.
6. Pray (or prey, depending on your proclivities).

I hope this helps.

Oh, yes. This may fail if your XMODEM program time-outs are too short.

amiga/main #737, from greggw [Gregg Williams, Senior Technical Editor, BYTE]:
a comment to 707

The "upload" and "download" commands will eventually disappear from BIX; they are not all that useful and they're hard to use. I know this is placing software outside of a conference, but *please* put listings, executable programs, and long text documents in the Listings conference. Type "join listings" to get there, then "?" for help. There is a separate "Amiga" file area.

Crunch [John Draper] has posted a set of C files there. Items in the Listings conference are tagged with a description, keywords, and the contributor's name.

If you have any questions, please let me know.

PRECISION VERSUS RESOLUTION

amiga/tech.talk #153, from al [Alastair J. W. Mayer, University of Guelph]

TITLE: Precision versus Resolution

I'm not sure the best single place to put this, so I'm going to copy it to a few other places. Apologies to those who read it twice.

(continued)

The title, "Precision versus Resolution," refers to two computer graphics terms whose meanings seem to have become confused in the wave of advertising hype for new micros, including the Atari 520ST and the Commodore Amiga.

"Precision" refers to how finely the coordinates of a given pixel can be specified, which boils down to the number of addressable points along each axis of an image. "Resolution" refers to the number of distinct dots that can be displayed in a given area of the screen.

Thus, saying the 520ST or Amiga has a resolution of 640 by 200 is totally meaningless. They may have a *precision* of 640 by 200 (in one particular graphic mode—different in other modes), but the *resolution* is entirely dependent upon the display device.

For example, no matter what graphic mode I'm in, there is no way I am going to get much better than about 300 by 200 (if that) resolution on a normal color TV. Why do I bring this up? In part, just for the sake of clarity of language. But also because I believe that, while the *precision* of the 520ST and Amiga is comparable (and indeed, the Amiga has higher precision in some graphic modes), the *resolution*—which visually is more important—differs between the Atari monitor and the Amiga monitor.

I have seen both (I am comparing the 640 by 200 color modes here), and my impression is that the image on the Atari monitor is much sharper and crisper (i.e., at higher resolution) than the image on the Amiga monitor. Indeed, the "feel" is that the resolution of the Amiga monitor is just barely adequate for the precision, while the Atari monitor has resolution to spare.

In all honesty, I have not had the opportunity to compare the two side by side. But I have used both for several hours and on several occasions, over the space of a week or so. It may be that my perception of the resolution of these monitors (and I've seen more than one of each, so discount individual variation) is affected by optical illusions because of the different diagonal screen size (Atari is smaller), or color choices, or text font.

But there *is* a difference between precision and resolution, and even with displays at the same precision, the visual effect is that the Amiga monitor has lower resolution.

What I'm interested to know is

1. Does anyone agree or disagree with my subjective feelings about these two monitors in particular?
2. And how about some comparisons with these machines using other (e.g., Sony, Hitachi, etc.) RGB monitors? (The point behind the latter is I am wondering about the quality of the signal put out by the Atari and Amiga—whether the fault lies in the monitor or the video circuits of the computer—if indeed there is a "fault."

Comments?

(N.B.—I'm not trying to start a war here; I'm just (a) clarifying terminology and (b) looking for info.)

amiga/tech.talk #154, from jsan [Jez San, Argonaut Software]: a comment to 153

Al—I disagree with your definitions of "precision" versus "resolution." We live in the *real world* here, and not some textbook definition.

People in the *real world* talk about the graphic resolution of a computer as its *x* and *y* addressable pixel range. Maybe in a textbook world you are right, but don't think for a second that people are going to start saying "precision" instead of "resolution"!

amiga/tech.talk #156, from al: a comment to 154

And in the real world, I can't display the 640 by 400 pixels of the Amiga on a color TV in any way that a human being can *resolve* them as distinct.

Resolution is display-dependent, not computer-dependent. By the same token, displaying C-64 output on a Sony monitor will give you fantastic resolution, but no more than 320 by 200 precision (but you'll be able to resolve those pixels easily).

IFF Graphics Protocol

amiga/softw.devlpmt #157, from gregr [Gregg Riker, Electronic Arts]

TITLE: IFF (Information Format Files) Is Available!
I mentioned that I used IFF files with the SlideShow. Allow me to elaborate.

Electronic Arts has a general interest in promoting standards, so we knocked heads with some people at Commodore-Amiga and came up with IFF.

IFF is intended to be used by any and all interested developers. It offers a convenient way of allowing programs to exchange data with one another.

For example, Graphicraft will be able to exchange files with Deluxe Paint and other EA products. The design is extensible, in that you may add your own types to the standard. There are programs available in C (public domain!) that will read and write graphic images in IFF format.

If you're interested in a copy of the spec, please contact Rob Peck at Commodore-Amiga. He can supply you with a copy. If you have any problems or need more information, please contact Jerry Morrison at Electronic Arts, (415) 571-7171.

P.S.: IFF covers graphics, audio, and text and is expandable!

amiga/softw.devlpmt #164, from pariseau: a comment to 157

IFF documentation will be included with the standard V1.1 release package. Commodore-Amiga has decided to adopt IFF as our standard interchange format. In the short term, this will affect graphics files produced by the paint packages (Graphicraft and EA's Deluxe Paint) as well as the format for text and graphics clips through the clipboard device.

amiga/softw.devlpmt #218, from al: a comment to 157

Is IFF NAPLPS-compatible? If not, why not?

A plea: Anyone out there doing any kind of software development that involves the software creating pictures: give it a NAPLPS option!

Either creating NAPLPS files describing the pictures, or interpreting NAPLPS and drawing the pictures. Or both. (NAPLPS includes text, too.) This will allow the exchange of such images and text with many other such systems—including via BIX.

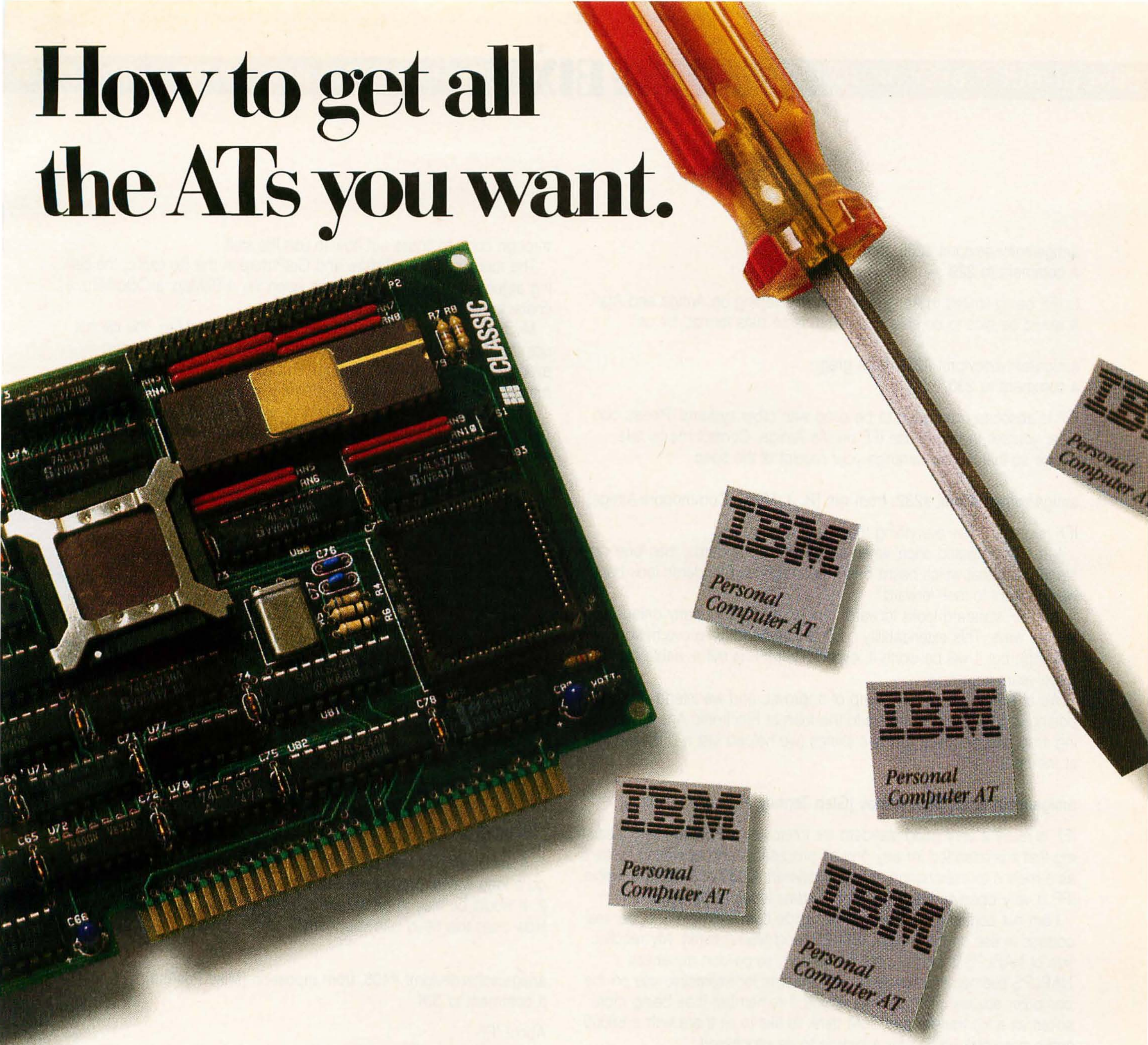
amiga/main #381, from cheath

Let's all study IFF and NAPLPS real carefully. I hope we don't get a split camp on this. I suspect most *fast* graphics programs will want to use IFF. Where is the NAPLPS spec? Let's get IFF up here!

amiga/main #399: a comment to 381

Another BIX subscriber said that NAPLPS is a good protocol for transmitting images over communication lines but not ideal for local graphics storage. He further stated that bit maps were best stored in IFF format and converted to NAPLPS format for transmission.

(continued)



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amiga/softw.devlpmt #230, from cheath:
a comment to 229

Is IFF being limited to Amiga? We are developing on Amiga and Atari. It would be nice to be able to use the same data format, for us.

amiga/softw.devlpmt #231, from gregr:
a comment to 230

IFF is *absolutely* designed to be used with other systems. Please consider yourself invited to use IFF on the Amiga. Contact me by telephone so that we can arrange your receipt of the spec.

amiga/softw.devlpmt #232, from rjm [R. J. Mical, Commodore-Amiga]

IFF is great. It has everything that we currently need.

I arrogantly stated once, when asked about standards, that "one can't standardize that which hasn't been dreamed yet. Standards look backward; I want to look forward."

The IFF standard looks forward. It is extendable in many unique and flexible ways. This extendability costs a little bit (bulk in overhead, processing), but it will be worth it, especially if IFF is still a viable standard three years from now.

We at Amiga give it our stamp of approval, and we intend on supporting it completely. Congrats to the folks at Electronic Arts for dreaming it up and polishing it until it shines (we helped just a little, and just at the end).

amiga/main #390, from tenney [Glen Tenney, Fantasia Systems]

IFF is really a very good standard for Interchange Format Files, meaning that it is intended for any and all processors and operating systems as a means to interchange as many different kinds of data as possible. IFF is very open-ended, allowing new data types to be defined.

I am not certain, but I believe that, aside from example C code, real code is in use on the Amiga, IBM PC, and Mac (I think). My recollection of NAPLPS is based more on Telidon, so pardon my errors. NAPLPS seemed too slow and cumbersome for interactive use on the computer actually sitting in front of you. I remember it as being more suited as a file transfer and don't think I'd like to sit there with a 68000 and a hard disk waiting for a picture to be processed.

amiga/tutorial #182, from cheath

Duck, I'd be upward-compatible if I knew how. I'm just using the documentation I have available, which is for V1.0. Don't the IFF routines make the same assumptions?

amiga/tutorial #184, from duck [Dale Luck, Commodore-Amiga]:
a comment to 182

The IFF data format actually specifies 8 bits per color. This is the encoding on the file and must be converted to the actual hardware/software abilities, like SetRGB4, so that the Amiga's 1000 colors 0-F map to 00-FF on the IFF (0 = black, ff = full bright).

I do not claim to know all there is to know about graphics, compatibility, upward portability. If any of you have suggestions, by all means make them; they may make it in the next release, but not 1.1—the window for enhancements is closed on this version.

amiga/softw.devlpmt #378, from cheath

TITLE: IFF Report

I set up the IFF graphics file load/save, using the C files sent by Electronic Arts. I used their packaged routine, which is designed to save a full-screen 320- by 200-pixel scene. It took a bit of wading through code to figure out how to use the stuff.

The routines are PutPicture and GetPicture in the file exiff.c; the calling arguments are fairly simple: an open file, a BitMap, a ColorMap, a character buffer, and bufsize.

My only problems came with setting up the ColorMap. You *cannot* use the ViewPort color map, and I also had trouble using a map allocated by the call GetColorMap. Finally, I allocated and initialized a map explicitly, and Rah smiled upon my efforts.

The performance was a bit sluggish. Before I had been using a simple "save 32000 bytes," which would take about 3 or 4 seconds for a load or save operation. With the IFF, loads take from 4–6 seconds, and saves take about 10 seconds. The routines added about 8K bytes to my execute file. Some of this can probably be reclaimed by removing unused routines.

The good news, aside from compatibility, was that the files averaged about 10K bytes versus the 32K that would result from a simple bitmap save. It is possible to store the images more compactly, but this is a reasonable balance between speed, simplicity, and compaction.

We are hoping to use the IFF standard for saving Atari 520ST graphics files. It looks like a fair amount of work to replace the Amiga data structures, but that only needs to be done once. We would be interested in hearing from anyone else interested in this.

Bugs:

1. Symbol "OFFSET_BEGINNING" (iffr.c, iffw.c) should be OFFSET_BEGINING. (Spelling is correct!)
2. Unable to write files on RAM: device. Files could be read from RAM: but not written to it.

Suggestions:

1. A set of simple, well-documented routines for screen dumps would go a long way to promote widespread acceptance.
2. It would be nice to be able to pass a RastPort rather than a BitMap. How does this tie in with clipboard?

amiga/softw.devlpmt #406, from mposehn [Mike Posehn]:
a comment to 378

About IFF

1. I'm not sure what you mean about not using the color map directly. Here's how I read a three-plane picture and set the colors:

```
/* Set default colors in case this picture doesn't have them */
for(n=0;n<8;n++) colorMap[n] = GetRGB4(vport->ColorMap,n+8);
/* Read the picture and color map */
success = GetPicture(file, bm, colorMap, tmpras.RasPtr,tmpras.Size);
if (success)
    {
    /* Ok, set the colors */
    for(n=0;n<8;n++)
        SetRGB4(vport,n+8,(colorMap[n] << 8) & 0xf,
                          (colorMap[n] >>4) & 0xf,
                          colorMap[n] & 0xf);
    }
```

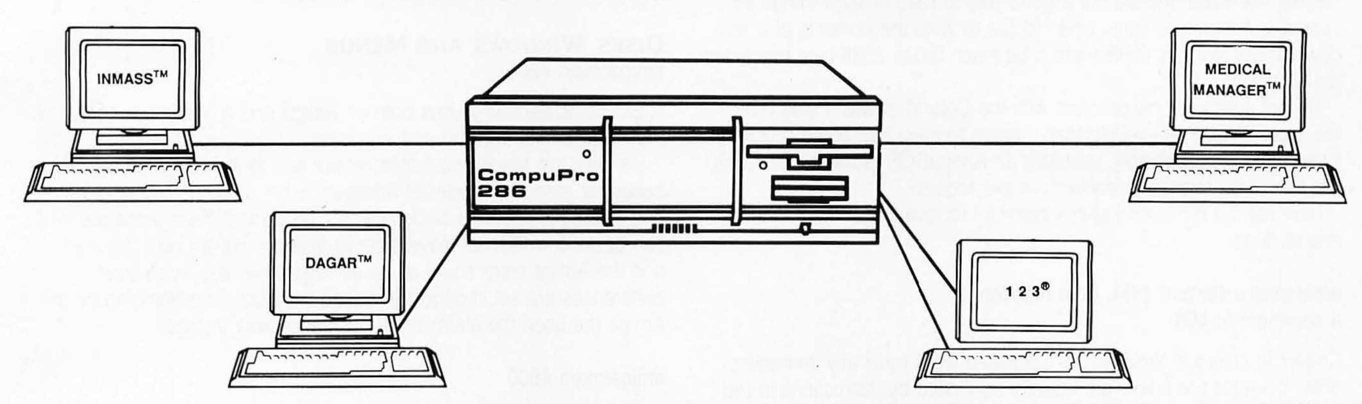
2. The IFF reading and writing speed is greatly improved in the version being released now. I upgraded to it today—you'll like it a lot more.
3. As you know it's OFFSET_BEGINING in the dos.h file. Some people can't put up with a little spelling error and insist on redefining it with a "#define OFFSET_BEGINNING OFFSET_BEGINING".
4. As far as passing a RastPort instead of a BitMap—I'm glad it's a bit map. Many months ago it seemed like every ROM routine wanted a RastPort and I was continually wasting code making fake RastPorts for

(continued)

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every little blit. The RastPort structure is needed for the image in your window or screen, but for all the other little images floating around in your code, bit maps are a lot simpler.

amiga/softw.devlpmt #408, from cheath:
a comment to 406

I agree that RastPorts are not a good way to read in such things as sprites, but there are times when I'd like to write the contents of a window without doing a ClipBlit into a bit map. Those 256K-byte machines are so small!

I'm not sure what my problem with the ColorMap was. I was using the screen ViewPort->ColorMap. I seem to have had some problems writing into a subdirectory, probably an AmigaDOS problem with seek, etc. Have you seen any problems in this regard?

How are the IFF sound specs coming? I'd love to get them whenever they're done.

amiga/softw.devlpmt #414, from mposehn:
a comment to 408

Changing colors in ViewPort->ColorMap won't have any immediate effect because the colors are actually controlled by instructions in the Copper list. So after changing the color map, you must rebuild the Copper list. Here's the magical incantation I use (if there is a better way, duck, please advise):

```
Forbid( );
MakeScreen(myscreen);
MrgCop(myview);
WaitTOF( );
LoadView(myview);
Permit( );
```

I've had no problems using subdirectories. You can either concat the path and file name before opening the file or use Lock( ) to gain access to the subdirectory before opening the file.

The IFF sound specs are not there yet. I need them very badly, too. Jerry Morrison at EA is still working on a way to factor everyone's requirements for music, MIDI, and sound effects into a clean spec.

amiga/softw.devlpmt #418, from cheath

TITLE: IFF for Sprites?
It seems to me that there is a lot of redundancy in using ILBMs and DESTs for defining animated images. The format allows a lot of flexibility and is nice for editing the images; however, for use in an application *program*, the overhead can be substantial for small images with many animations. Has anyone defined a FORM designed for applications use of sprites?

amiga/softw.devlpmt #428, from mposehn:
a comment to 418

In Deluxe Video we read files in a simple IFF animation scheme called an ANimated BitMap object or ANBM. It's a simple sequence of frames of the same size and relative position with an IFF file structure like this:

```
FORM ANBM
SEQN
LIST ILBM
  PROP ILBM
    BMHD
    CMAP
  FORM ILBM     } repeat this part once per frame
    BODY        }
```

We have written a program called "Framer" that lets you cut a multiple frame sequence out of a picture (an IFF file created by Deluxe Paint or by Graphicraft) and save it in this ANBM format. You can then put that animation into a video or use it in some other program. We plan to include Framer with Deluxe Video.

Hopefully, someone will write a tool for creating more complex animated objects and save them in IFF format.

Disks, Windows, and Menus

amiga/main #806

A BIX participant who uses both an Amiga and a MacIntosh compared mouse functions, menus, and windows.

He liked the Mac's one-button mouse and found using the second button for menus a moderate annoyance. He found it frustrating that he had to put his windows back to where he wanted them, since the Intuition desktop would not leave them in position. He felt both the Mac and the Amiga were equal as far as responsiveness, once your preferences are set, though he missed the clock time-stamping on the Amiga (he used the alarm-clock desk accessory instead).

amiga/main #800

Another Macintosh/Amiga user commented that she was accustomed to the responsiveness of the Amiga. She didn't like the response of the Mac with a one-button mouse but hadn't tried the Atari.

amiga/main #809

Another Amiga owner offered a way to make Intuition leave the disks and windows the way you had them. With the Snapshot menu option, you should indicate the disk concerned as "selected."

amiga/main #812, from pariseau:
a comment to 806

Icon and window positions on the Amiga can be recorded using the Snapshot menu item. Taking a snapshot on an icon whose window is open records the window position and size as well as the icon location. You can use Extend Select to snapshot a bunch of stuff at once—hold down either Shift key while clicking each icon with the Select button (left mouse button); release Shift key and choose Snapshot with the Menu button (right mouse button).

We chose explicit rather than automatic position recording because

1. We wanted to have a disk eject *button* so that folks wouldn't get paranoid about not being able to remove their disks.
2. Given that we couldn't cache the positions in memory, we felt it was too sluggish to write them out every move.

Oh, yes, the snapshot stuff for windows only works for Workbench disk and drawer windows—there is currently no way to change the initial window position and size for an application window such as the clock.

By the way, is it true that the ST does not let you arbitrarily position your icons?

amiga/main #814 [Tom Thompson, Technical Editor, BYTE]:
a comment to 812

Thanks for the inside design info on something apparently "simple" as saving the "desktop." Of course, then you run the risk of somebody ejecting a disk during the update sequence (it's mentioned in your manuals) or using a paper clip to physically eject the disk when the Mac won't let you have it. An interesting choice, no?

(continued)

AMIGA IBM PC EMULATOR

amiga/main #778, from atm [Andrew McLaughlin]

Does the IBM PC emulator allow the Amiga to operate "normally"? By that I mean, can you boot the emulator, start something running under the emulator, and then also run Amiga programs (e.g., Boing!)?

Also, what is Commodore planning to do when they finalize the ROMs? Will we have to ship them to West Chester for service or ?

amiga/main #787, from cheath:
a comment to 778

The emulator is "stand alone"; it takes over the whole machine.

Regarding ROMs, it has been a unanimous plea among developers to *never* put the ROM software in ROM. This is to allow alternative operating systems like UNIX to run without using any extra RAM. If the Writable Control Store is always there, alternative operating systems can count on it. The short-term policy of Commodore seems to be to keep the WCS. I don't know if they have a long-term policy.

MORE ABOUT BOING!

[Editor's note: For more on this topic, see Best of Bix—Atari]

amiga/main #736, from greggw

Regarding the bouncing-ball demo, is it true that the Amiga bouncing-ball demo *could* have been faster but was slowed down to make it look realistic? (Just idle curiosity.)

amiga/main #747, from greggw:
a comment to 736

Folks, Bob Pariseau sent me a letter that includes the following remarks about the Boing! the bouncing-ball demo; I thought I'd share them. (Letter excerpt follows.)

The ball can be made blindingly fast without any significant increase in 68000 overhead. The ball rotation is done by color cycle animation. Each red and white patch on the ball is actually 7 strips of color.

Push the Workbench screen to the back while the ball is forming (LeftAmiga-M), and you'll see what I mean. We assign 14 of the 32 color registers to ball rotation. At any instant 7 are white and 7 are red. We cycle the colors through them to make the ball appear to rotate. To rotate faster, just cycle faster. How fast can *you* change 14 memory locations with a 68000?

The ball bouncing is done by changing the start-of-data pointers for the ball/shadow bit planes with respect to the grid bit plane. By clever use of the video DMA pointers, the grid appears stationary while the ball appears to move. Again, no blitting is involved. Again, making it go faster is easy.

Curiously enough, the hard thing is making the ball go *slowly* and still appear to be smooth. We can get as slow as you see on the Amiga because, with 32 color registers, we can afford to burn 14 just on ball rotation.

ATARI

[Editor's note: Before using February's instructions to upgrade your 520ST, read Atari/tech.st #239 or download ST.DOC from BYTEnet Listings.]

This month, Dave Betz describes his experiences in porting XLISP successfully to the Atari 520ST, David Allen presents some background information on the new Grolier/Activenture CD-ROM encyclopedia, and there are comments on BASIC, DEGAS, and the Atari Boink demo.

XLISP

atari/tech.st #122, from dbetz [David Betz, Contributing Editor, BYTE]

I just got my Atari ST development system and software. I'm intending to port my XLISP interpreter to the ST. My first goal is just to get the generic version running on the Atari. Then, I'm going to add some support for interfacing with the GEM graphics routines. My first problem is that, looking through the C compiler disk that came with the development package, I seem to be missing the setjmp.h include file that supports the setjmp/longjmp library routines. These routines are mentioned in the CP/M-68K C manual that came with the development package, but I have been unable to find the supporting include file. Anyone have any idea where I can get a copy of it (it should be only a single line long)?

atari/tech.st #125, from dbetz

Well, I've just gotten all of the XLISP source code to compile and link on my ST (but not run, unfortunately). I thought that I'd share something of my experiences in accomplishing this.

First, I'm sure that I had the same reaction as everyone else the first time I realized the number of cables required to hook up this beast. I have two drives and both monitors, so I guess I have the maximum number of cables possible. Before I could do anything with the machine I had to buy one of those multi-way power adapters just to free up enough outlets to plug in the four power cables! It really is pretty easy to set up, though. I didn't read any of the manuals and managed to get it to work the first time. Once I had all of the cables and power supplies (three) hidden behind the machine and under the table, it really looked nice sitting on my computer table (next to an old DEC Rainbow with only 256K of memory).

The first thing I needed to do was to copy all of the XLISP source code from my Rainbow to the ST. I used a program called LCTERM on the Rainbow and Kermit on the ST. The transfers happened flawlessly! I typed a single command on each machine and transferred all 24 XLISP source files to the ST without any errors at 9600 baud. This took a while, but since everything happened automatically, I didn't have to stay and babysit. I went off to the living room and read about GEM.

After transferring the files, I had to do some minor editing in order to select the correct options for compiling with the DRI C compiler. I used MicroEmacs and had no trouble changing the few lines required to tailor XLISP.H for the ST.

Then I started to compile the sources. My first problem was to track down three include files that should have been part of the C development package but were left out of the version that I received. The files in question were setjmp.h, ctype.h, and math.h. I searched through all of the disks that came with the development package and couldn't find any of them. The C documentation mentioned the existence of both setjmp.h and ctype.h but didn't even mention math.h. Well, in order to proceed, I made an educated guess about what went into those files and created my own versions. After this, all 23 XLISP source modules compiled without errors!

Then it was necessary to link all of the resulting object modules. I used MicroEmacs to create a batch file to run the LINK68 and RELMOD programs to create an executable version of XLISP. Because there are so many object files in XLISP, I had to create a separate input file for the linker. This was easy to create using MicroEmacs also. I had no trouble linking XLISP and creating an executable file with RELMOD. My only problem now will be to find out why XLISP doesn't work! When I run XLISP, I get the banner line and then the program immediately exits. Just before exiting, I get two tiny mushroom-shaped characters at the left-hand side of the screen centered vertically. I have

(continued)

no idea what these mean or why the program just exits without doing anything, but in the next few days I hope to find out.

All in all, I am impressed with the ST. It hasn't crashed as much as I had been led to believe that it would. It has a very nice crisp monochrome display (I haven't really tried the color monitor much yet). The keyboard seems reasonably good. The desktop software seems to work well, although I did experience some strange behavior after compiling about 15 of the 23 XLISP source files. When one of the compiles finished and I returned to the desktop, one of the disk windows had mysteriously been closed. When I tried to reopen it, I was unable to. I had to reset the machine to continue with the next compile.

The COMMAND.PRG doesn't seem to be very useful on its own. It doesn't have any way to copy files from one disk to another. It doesn't have a way to rename files, and its delete program (RM.PRG) doesn't accept wild-card file specifications. When I invoked MicroEmacs from the command-line interface, I ended up in the editor with no visible cursor! I was able to edit, but I had to insert dummy characters to determine where the cursor was. Fortunately, it isn't really necessary to use the command-line interface. Everything that you need to do can be done through the GEM desktop.

In summary, I really am impressed with this machine. I like the crispness of the display in monochrome and the window system seems to be fairly responsive. I wish the packaging was a little nicer (fewer cables, maybe one built-in disk drive, no external power supplies). It could use higher capacity disks. (I am aware that a double-sided disk is now available. It should probably be made standard.) What I *really* like about it is that I get a fast, 68000-based machine with a high-resolution bit-mapped display for under $1000! I think that this machine has quite a bit of potential, and I intend to continue to explore its capabilities. I want to develop a good interface to the graphics support from within XLISP, and I'm sure that I'll have some comments about *programming* with GEM in the process.

atari/tech.st #126, from jsan [Jez San, Argonaut Software]:
a comment to 125

If you are not already linking the file apstart.O to the front of your object files, then please do so! It sets up and reserves a Stack area for your application program to use and thus is vital to the correct execution of your program. Simply ensure when linking your file together that apstart.O is the first one in the list.

Failing that, two mushrooms means an address error (I think, or is it bus error!?).

Let me know how you get on.

atari/tech.st #128, from dbetz:
a comment to 126

I am linking with gemstart, gemlib, and libf. I just noticed that the default stack size is only 1000 bytes, so I'm going to try increasing that to about 16K and see what happens. Thanks for the advice.

atari/tech.st #129, from jsan:
a comment to 128

I'm not familiar with gemstart, so I wouldn't know if it performs the functions of apstart too, but just in case, please try linking in apstart *before* gemstart and see what happens!?

atari/tech.st #130, from dbetz:
a comment to 128

Well, I increased the stack size to 16K by reassembling gemstart.s and XLISP came up and printed its prompt. I tried typing an expression (just a number) to see if it really worked and got no response. XLISP thinks that all lines need to be terminated by a linefeed, and I suspected that the run-time library might be looking for a CR-LF pair at the end of a line, so I typed Ctrl-J (the code for LF) and XLISP *printed* the result of evaluating the expression! I would have been impressed except that immediately after printing the result, XLISP exited back to the desktop. The only reason that XLISP would do this is if the next call to getc returned end-of-file. In order to test the behavior of terminal input in a simpler environment, I wrote a *very* simple test program. Here is the text of the program:

```
#include <stdio.h>
main( )
{
  int ch;
  for (;;) {
    ch = getc(stdin);
    printf("%02x ",ch);
    if (ch == '\n')
      printf(" \n");
  }
}
```

This program just reads characters from stdin and echoes the ASCII code of the character in hexadecimal. It starts a new line every time it gets the LF character. I ran this program, and absolutely nothing happened when I typed characters. I did some further investigation and found out that getc(stdin) was *always* returning −1 (end-of-file). I have no idea what I am doing wrong and am not sure how to proceed from here. It seems as though the standard I/O library just doesn't work correctly when reading from the keyboard.

In addition to this problem, I have been continually plagued by disk windows getting closed automatically on return from an application. Whenever this happens, I am unable to reopen them. I must reset the machine and start the desktop over again.

While I still like the hardware on this machine, the software seems to leave a lot to be desired. Why doesn't it come with its own development documentation? The C manual and the system documentation are for CP/M-68K; the GEM documentation is for PC-DOS. After taking a few minutes to look at the documentation for the Amiga, I am left with the feeling that this machine was released too soon. It doesn't really have adequate development tools. I suppose that someone will point out that the Macintosh didn't have any decent development tools when it was released either. The difference is that the ST doesn't come with any useful applications (like MacWrite and MacPaint) or any decent tools to build your own applications. In its current state, it's a not a very useful machine for either a software developer or an end user. I'm going to continue to struggle with it for a while. Maybe the support for developing native applications is better than the support for porting generic programs like XLISP.

atari/tech.st #131, from jsan:
a comment to 130

On CompuServe, Russ Wetmore (sysop of Atari SIG) has uploaded the C stdio header file. I suspect it will work better than the ones you are presently using.

I'm afraid I have no experience of C. I only use the ST from an assembly-language viewpoint and can easily help you with I/O that bypasses TOS, but I can do nothing much to help you with OS calls of any description.

(continued)

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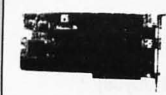
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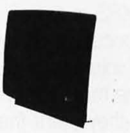
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atari/tech.st #140, from dbetz

Well, I finally finished my port of XLISP to the 520ST. It seems to work pretty well. It is a bit faster than XLISP on the Macintosh, but you have less space to work with on an ST than on a 512K Macintosh. I assume this will be fixed once the OS comes out in ROM. The only major problems that I encountered were some missing include files (ctype.h, setjmp.h, and math.h). I invented my own versions of those files and was able to compile all of the XLISP code without further problems. My next problem was that the standard I/O library that comes with the DRI C compiler doesn't seem to work when doing I/O to the terminal (keyboard/screen). I ended up writing my own code for terminal I/O. Once those two problems were solved, XLISP came up and ran without a hitch. I uploaded it to the Atari area of the Listings conference. The file is called XLISP.TTP and should be downloaded in binary mode. The documentation for the ST version is the same as the IBM version and the Macintosh version. You should be able to find the documentation text file in the Macintosh area of Listings under the name XLISP.MEM. If you download XLISP, please let me know what you think and report any problems you might encounter.

CD-ROM

atari/tech.st #11, from dpallen [David Allen]

Grolier engaged with Activenture to produce this CD-ROM as the first practical exercise of a new CD-ROM authoring language by Activenture (a company formed by Gary Kildall of Digital Research fame) called KRS, or Knowledge Retrieval System. This is a high-level "language" that is designed to work on a DEC VAX-11/750. When fed with any large database from a master machine-readable source, KRS creates a "file inversion" or electronic index of the database. This can be as large as the database itself, and in the case of the Grolier encyclopedia, does, in fact, occupy 60 megabytes of CD-ROM real estate, the same amount that the encyclopedia itself occupies. KRS is written in C.

In comparison, the encyclopedia itself also occupies 60 megabytes of CD-ROM space and is the equivalent of 10 volumes of 10,000 pages of nine million words. So there is room for *three* more totally different "encyclopedias" of the same size! (Don't look—they aren't there!)

The file inversion is a specially constructed file of *all* of the keywords in the database less some "stop words." Stop words are those words that appear in the database more than 32,767 times and are considered unworthy of search. These include words such as "the," "an," "and," "of," and about 25 other words in the case of the encyclopedia.

The user may institute a search for any combination of keywords and the KRS will come back with suggestions. For example, if a student was writing a report about the relationship between Eisenhower and Nixon, he might ask for all the entries with those two names. The system would respond by asking if the user wished those entries with the keywords in the same paragraph or same article. Within 3–5 seconds the system will deliver a list of all entries so described. The user may apply any sort of Boolean logic to enter the keywords (all that have word A but not word B, or all that have word A and word B or word C, etc.).

Activenture is promoting itself as "optical typesetters" and is prepared to massage *any* third-party database with KRS for similar results.

The encyclopedia disk will be marketed by Grolier, and there will be a parallel marketing campaign for the necessary hardware to play the disk on. The hardware will not be OEM'd by Grolier but will be marketed by the manufacturer of the hardware. No official announcement yet of the brand(s) of CD-ROM hardware to be available at that time nor of the computers to be initially interfaced, but my intuition says to expect that the initial computers to be interfaced will be the IBM PC (and clones) and the Atari ST.

atari/tech.st #39, from dmenconi [Dave Menconi]

I can't help but think that the encyclopedia is going to be important. I have always thought that the *real* use for computers would be to supply users with a library of information in an easily indexed way. That way the user could find facts quickly. This will eliminate a lot of the half-truth myths and "pseudo-science" that plagues us now. Is anyone writing a more sophisticated access system for all that data than just a word search? Like something that would answer the question: "What is the relationship among average rainfall, the value of the dollar, and the age of the president?" I admit that this data is not going to be on the first disk, but there will be other disks and a word search just doesn't do it. Anybody have any ideas about the best way to access all that data?

atari/tech.st #40, from dpallen:
a comment to 39

I played around with the Grolier on an IBM PC last week. KRS really works very well, although I think they are a bit optimistic on their maximum search time of 5 seconds. More like 10.

I exercised using some Boolean functions and it handled them very nicely. (Find A and B and C; find A and B and not C; etc.) Came up with just what I was looking for.

Philips was showing off a new CD-ROM database manipulation consisting of a newspaper file with pictures in both black-and-white and color. Used an AT&T video digitizer board that worked really well. (Expensive.) It also provided sound over still voice with each picture.

atari/tech.st #41, from neilharris [Neil Harris, Atari Corp.]:
a comment to 40

I think the way to go is to develop a parsing language similar to the one that Infocom uses in their adventure games. Searching the database itself is easy using Activenture's inversion process, but some intelligent preprocessing would add a dimension that would make life easy.

FIRST WORD ON BASIC

atari/news.st #136, from jimj [James Joyce]

I sent in my registration card and Atari sent me ST BASIC this week. The package included disk and manual. The manual is much better than the Logo manual I received when I bought my system. There are some typos and errors. One major omission is a chart for the SHAPE argument of WAVE. (And I sure would like to know how to use WAVE.)

The sample programs they give in the back are nice. The one titled "Low Resolution Demo" seems to be excessively slow, but I haven't checked to see if I inserted my own typos here, so it may be my fault.

BOINK AND THE AMIGA

atari/non.tech.st #102, from jsan

In our latest game (on the Atari ST) we've got sampled sounds and speech working! Yes, it *can* be done. It's just nowhere near as good as the Amiga's hardware, since ours is done in software and requires about 6 percent overhead in processor time to accomplish an 8-kHz bandwidth. It's not bad, nevertheless.

I would say that Atari's Boink program is a stunning effort of high ingenuity in trying to beat the Amiga. I'm very impressed that they got it *that good*!

atari/non.tech.st #105, from cheath [Charlie Heath, MicroSmiths]:
a comment to 102

> Six percent of cycles; what percent of development effort?

(continued)

atari/non.tech.st #106, from jsan:
a comment to 105

Hmm, what do you mean what percent of development effort!?

If you mean how hard was it to write, then, well, it was an offshoot from the normal Sound (d)effects subroutines that we had to write *anyway*, and so we decided to go one stage further and add full sampled synthesis (which allows Speech, or any other digitized waveform). It's less than a week's work for a full-time machine code programmer, but most ST programmers don't do machine code. (C seems to be overpopular!) Here in England, people are raving about Modula-2, but as far as I'm concerned nothing beats machine code for either execution or readability!

atari/non.tech.st #112, from neilharris:
a comment to 95

After seeing the two bouncing balls (ST and Amiga) side by side for 5 days at COMDEX, not one person thought Amiga's was any better, faster, or smoother! Any arguments?

atari/non.tech.st #113, from jsan:
a comment to 112

Yes, here's an argument.

The Atari bouncing-ball demo is running *flat out*, using every trick in the book to get its speed and smoothness working. It is using 100 percent processor time, and so nothing else could be working at the same time, nor could two or three bouncing balls be working at the same time.

The Amiga bouncing ball, on the other hand, is done using total *hardware* register modification. What that means is that not only the ball's spin, but even its *movement* is done without any loss of processor speed or software. It *moves* the instant that the bit-plane Start registers have been altered, whereas the Atari one must block move the entire beachball in order to make it move. The bottom line is that the Amiga bouncing demo is an incredible effect, considering it's using a *negligible* amount of processor, whereas the Atari gains the effect working *flat out* as hard as it can!

The Amiga can, of course, pull up a screen in front of or *behind* that bouncing ball, and the user can pull the screen up or down interactively with the mouse while the ball is still bouncing (and boinging in stereo, I might add!). The Atari cannot do that, as it has no hardware registers at all, except for a Palette.

The reason the Atari ball appears to spin faster is that Atari used fewer colors to define the ball, half the number that the Amiga version used; thus the Amiga one spins smoothly—much more smoothly than the Atari version ever could.

Having said all that, I'm *very* impressed that the Atari programmer managed to get it Sooo Goood on an ST! I didn't think that kind of graphics was possible on an Atari. He must have done pretty well!

atari/news.st #159, from duck [Dale Luck, Commodore-Amiga]:
a comment to 158

It was probably running faster because that is the way the programmer wanted it. It looked *very* nice.

atari/non.tech.st #1⁴⁷, from duck

The first Amiga version was programmed between the hours of 12 midnight and 4 a.m. on about January 7, 1984. Although the initial spinning ball had been created some time before then.

About May, another 8 hours was devoted for sound and left-right bounce effects. Once the demo was running, little was done to make it faster; it seemed to create the right effect.

[*Editor's note: For further comment from the staff at Commodore-Amiga, see the comments of Bob Pariseau in Best of BIX—Amiga.*]

DEGAS

atari/news.st #117, from rsimonsen [Redmond Simonsen]:
comment to 115

[*Editor's note: This dispatch is in response to comments by thud, Tom Hudson, who implemented DEGAS.*]

If you plan the program for use by both casual *and* serious users, joystick, mouse, and tablet support is really desirable. Serious drawing requires a stylus-like instrument. Unfortunately, such tablets are not cheap, therefore not widely owned nor supported by commercial software.

By way of a compliment, your program made me feel better about the potential of the 520ST, and I'm now actively rooting for its success. know how feature glut can make one freeze in anticipation of all that revision. But press on.

I am struck by a false separation in software categories between "paint" programs and "drawing" programs (with the latter being more elaborate and expensive and usually object-oriented). To artists and architects, there is little to applaud about such a dividing line in technique and approach to putting images on the screen.

Speaking of screens, is that of the ST orthogonal; i.e., does the distance between vertical pixels equal the distance between horizontal pixel positions? If not, does your program compensate for the appearence of images on the screen versus the same output on a printer? My PC Paint does not and it's very annoying. Moreover, mathematically correct circles are visually incorrect on the screen of my AT&T 6300 (they look like ellipses) but correct when printed (but all the freehand stuff in the drawing gets squashed, of course). Graphic software for machines like the ST ought to be sophisticated enough to compensate for these differences.

atari/news.st #119, from thud [Tom Hudson]:
a comment to 117

DEGAS generates true circles on the ST, as far as the *x* and *y* size is concerned. Unfortunately, the screen shows them as *slightly* elliptical. Outputting the picture to a printer or plotter with a correct aspect ratio will correct it (but, as you say, freehand drawing will be squashed). It's a no-win situation.

atari/news.st #120, from rsimonsen:
a comment to 119

Why can't DEGAS have an intelligent picture processor that remaps the picture to compensate for the peculiarities of various printers? All drawing on the screen should be done on a "looks right" basis (i.e., circles are *not x,y* correct, but they *look* right). When the picture is printed instead of doing a simple screen dump, the picture is redrawn into a RAM buffer with the *y*-axis appropriately scaled to compensate for the particular printer being used. Sounds like pretty simple software to me.

I wrote a turtle-graphics system on the Apple II (in FORTH) that did circle and polygon compensation on the screen. I didn't do a printer output processor, but all you'd have to do is rotate the bit map and rescale the now-horizontal lines. Correct?

atari/news.st #121, from mdulcey [Mark Dulcey]:
a comment to 120

It's not that simple. The catch is that scaling the bit map like that (especially by a small scale factor) will lead to excessive jaggies on

(continued)

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some objects. Remember, you want the *text* to print correctly, not just the circles and polygons.

The *real* solution would seem to be for Atari to adjust the monitors so the aspect ratio is correct. The pixel counts are appropriate for this, given the size of the screen.

atari/news.st #139, from al:
a comment to 121

No, no, the *real* solution is device independence.

atari/news.st #123, from rsimonsen:
a comment to 121

Actually, I assert that it *is* that simple. It should at least be attempted and tested. Yearning for Atari to change their monitor is a cop-out, since they'll never do that to address this problem.

atari/news.st #125, from thud:
a comment to 120

Actually, DEGAS doesn't do a raw screen dump but uses special printer drivers that may scale the output any way they like. Therefore, in theory, all the printers/plotters could have perfect aspect ratios, as long as they were written properly. In practice, though, most dot-matrix printers give trouble, because their pin-spacing/linefeed ratios aren't infinitely variable to provide accurate scaling. Somebody give me a laser printer.

atari/news.st #126, from thud:
a comment to 123

It could be done to a certain extent, but your average, casual computer user isn't going to care about it that much. Plus, the cost for the additional factory alignment would probably be a no-no for Atari right now. Not to mention the in-the-field variables involved.

atari/news.st #128, from rsimonsen:
a comment to 125

Regarding scaled pictures: On my AT&T 6300 using PC Paint, the ratio of depth to width is 1.2; i.e., a square box (in terms of pixels) measures (with a ruler) 20 percent deeper than its width. I presume it's something similar on the 520ST. What should happen with regular polygons, circles, et al., is this:

1. The on-screen image is presented as visually correct (so, for example, a square 100 pixels wide would only be 83 pixels deep). This would make it look correct on the screen.
2. When printed (presuming we have a printer that spaces its dots evenly in both directions), the image is first rotated 90 degrees in memory, and then the bit string is scaled by 1.2, then printed.
3. Printers that were incapable of producing a truly square grid of dots would have the picture processed by a scaling factor that approximated their aspect ratio.
4. The user would be given the option of printing the picture without processing.

Since the greatest use of pictures is "on screen," it is important to be able to produce geometric figures that look geometric and can be easily made so (as opposed to the approximation methods one must now resort to by twiddling with the mouse-cursor).

atari/news.st #131, from mdulcey:
a comment to 128

This procedure won't produce optimal results in all cases. Suppose I carefully design a font to use only straight and diagonal lines (say I don't like jaggies). After this is scaled, it won't look right anymore.

There are only two good solutions:

1. Use object-oriented draw software.
2. Use monitors with the same aspect ratio as the printer.

atari/news.st #138, from al:
a comment to 117

Of course, he said, climbing onto a convenient soapbox, if such "paint" and "draw" programs simultaneously saved away a list of the instructions used in creating the image (in a convenient notation like NAPLPS, hint, hint), then circles would be circular whatever the output device.

Rather than simply transfer the screen bit map to the printer (and end up with aspect-ratio problems), simply pass the NAPLPS file to an appropriate printer driver, and there you are.

(And you have the added benefit of being able to send the pictures over phone lines in reasonable amounts of time—and displaying them on otherwise incompatible computers.)

See also (plug, plug) the conference Graph.exch, particularly the "naplps" topic.

IBM

This month we are featuring the discussions in the MS-DOS conference. The section on DOS commands focuses on FORMAT errors and use of the RESTORE command. Another discussion covers hard-disk slowdowns.

MS-DOS COMMANDS

ms.dos/commands #90, from mose [Michael Mosely]

Backup using DOS 2.0: Help, please. Awhile back I used the BACKUP command to back up a directory or two using DOS version 2.0 on an IBM PC XT. Today I tried to restore them using "RESTORE A: C:." Well, the system clicked and whirled and told me there were no files to restore. DIR finds all of them including the BACKUPID.@@@ file. I'm kind of stuck because I can't even do a straight COPY operation and have my .EXE file execute. The files copy okay with the same number of bytes and all, but when I try to run them the system complains about not having enough memory. BACKUP must diddle something. Can anyone offer advice or sympathy?

ms.dos/commands #91, from petewhite [Pete White]:
a comment to 90

If you were backing up a subdirectory, try the "/S" option. Other than that, RESTORE should work.

ms.dos/commands #92, from rich [Rich Sidney]:
a comment to 90

Try

C>RESTORE A:*.* C:/S

You have to tell RESTORE which files to restore. It does *not* assume any files. As you gave it a null filename, it restored nothing.

ms.dos/commands #95, from kebrown [Ken Brown]:
a comment to 90

You will not be able to just copy the files off the backup disk, you

(continued)

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have to use RESTORE. BACKUP adds a 128-byte header to the front of each file as it backs it up, so if you copy an executable file off a backup disk it will not run. If there is really something wrong with the backup disk and RESTORE won't get it, there are programs on some bulletin-board systems that allow you to copy individual files off backup disks.

ms.dos/commands #96, from lmowatt [Lee Mowatt]:
a comment to 91

RESTORE will only restore those files on disk that came from the directory in question. If it finds none from the directory, then it restores none.

ms.dos/commands #98, from leroy [Leroy Casterline]:
a comment to 94

Under Compaq DOS 2.1 and PC-DOS 3.0/3.1, RESTORE A: C:/S works fine. I haven't seen a version of DOS that required the "*.*". The /S is very important, however, if the files were backed up from a subdirectory. RESTORE isn't smart about restoring files and must be told to put them back in subdirectories with the /S. Another possible cause is a damaged BACKUPID.@@@ file. Check the length of the file; if it's 0 bytes long, it's bad and RESTORE will fail. One possible solution is to use UNDOBACK (a public-domain utility) on each individual file. UNDOBACK removes the "header bytes" that BACKUP puts at the beginning of every file as it writes them to the disk. A better solution is to use another public-domain utility called "BF" to recreate the BACKUPID.@@@ file. I've got both these utilities and will be glad to share them if need be.

ms.dos/commands #100, from georgehoffman [George Hoffman]

FORMAT 3.x errors?: I've been getting drive timeout/not ready errors trying to format floppies under DOS 3.0/3.1 using Qume 142 drives on an XT. Any suggestions? All other disk operations seem to work fine. It's *not* head settle or motor start parameters, since I've already played with these.

ms.dos/commands #103, from billbourn [Bill Bourn]:
a comment to 100

I would amend the query to include a request for comment on the status of the previous releases' FORMAT problems with storage placement. FORMAT used to have a bug that gave similar problems as George mentions because it didn't like its starting storage location. Something about the work area not being partitioned properly. Adding a buffer or two "fixed" it so you could format again. That was such a well-known problem that I would be surprised if it is still lurking in 3.1. I also seem to remember someone having drive not ready problems with a drive whose door lever had a small crack that prevented complete and tight closing of the drive hub inside. Hard to detect, but push on the lever a bit to see if you can get some other results.

ms.dos/commands #106, from rsimonsen [Redmond Simonsen]

How do I get my AT&T 6300 to send DOS-level print output to my second parallel port? MODE is no help. Isn't there a way to do this from DOS (without some sort of utility program)?

ms.dos/commands #108, from mhaas [Mark Haas, Contributing Editor, BYTE]:
a comment to 106

I strongly recommend getting a copy of *PC Secrets* by James E. Kelley. On page 87, it has an assembly-language program for swapping LPT1 and LPT2. It also contains tons of other useful goodies.

ms.dos/commands #116, from inci [Claude West Jr., AT&T]:
a comment to 106

Your MODE command should have provisions for LPT2. My copy of MS-DOS 2.11 does. Look in one of the previous issues of *PC World*; in the *.* Global column; there's a program to switch between LPT1 and LPT2. [*Editor's note:* PC World, *November 1985, page 95.*]

ms.dos/commands #121, from mmb [Michael Bosen]:
a comment to 106

There is a book called *A Guide to the AT&T PC* by Robert Traister, published by Prentice-Hall. It's not terribly good, but that's from one person's point of view. It has some technical information, some info on software, running XENIX, etc. Nothing is done to completion, but there's a little for everyone. As far as really technical stuff, AT&T has the *Programmers' Guide* available at around $65. You might like to visit The Softline BBS in Wakefield, MA, at (617) 245-4909, where you'll find a newly formed AT&T Users Forum.

ms.dos/commands #125, from bomb [Jerry McReynolds]:
a comment to 106

I can help you out on redirection ">" and COPY commands; print screen and control print screen are a different story.

If, for instance, you wish to send a listing of your directory to the printer that sits at port 2, you would type the following at the system prompt: DIR >LPT2:; all output that is supposed to go to the screen will be redirected to port 2. Likewise, if you wish to list a text file to port 2, you can type: TYPE filename >LPT2:; if you wish to list several files to the printer at the same time, try: COPY *.TXT LPT2:. You can also use the supplied print queue PRINT.COM. The first time you load PRINT.COM it asks you to supply the default printer port.

Past that, you have few choices; move your printer, change the physical address, or intercept and reroute printer calls.

Keep in mind that PRN is a filename for LPT1, as AUX is a filename for COM1. That does not stop you from writing directly to the device as in COPY CON LPT2:.

HARD-DISK SLOWDOWNS

ms.dos/other #119, from tfritter [Terry Ritter]

I have a Leading Edge PC with a hard drive that seems to have a peculiar problem associated with the disk. There is no data loss, but, at a particular "place" on the disk, file-storage operations seem to take about a hundred times longer than they should. My guess is that there is a bad region on the disk, and the delay I see is the result of software error correction in action. This is not easy to tell, though, since the controller does not report an error—at least, not through the BIOS call. (I use a disk error reporting program resident in memory.) The reason I suspect a "place" on the disk is that it occurs around a particular value of free storage; if storage is allocated sequentially, the storage being allocated there would always be the same.

Anyway, this is an irritation, and I would like to remove it. If I knew how to test for this condition, maybe I could force that storage to be nonallocatable somehow. Anybody got any ideas?

ms.dos/other #120, from jimkeo [Jim Keohane]:
a comment to 119

Not quite a factor of 100, but I've seen severe slowdowns once the number of directory entries (main or subdirectory) exceeds some value.

(continued)

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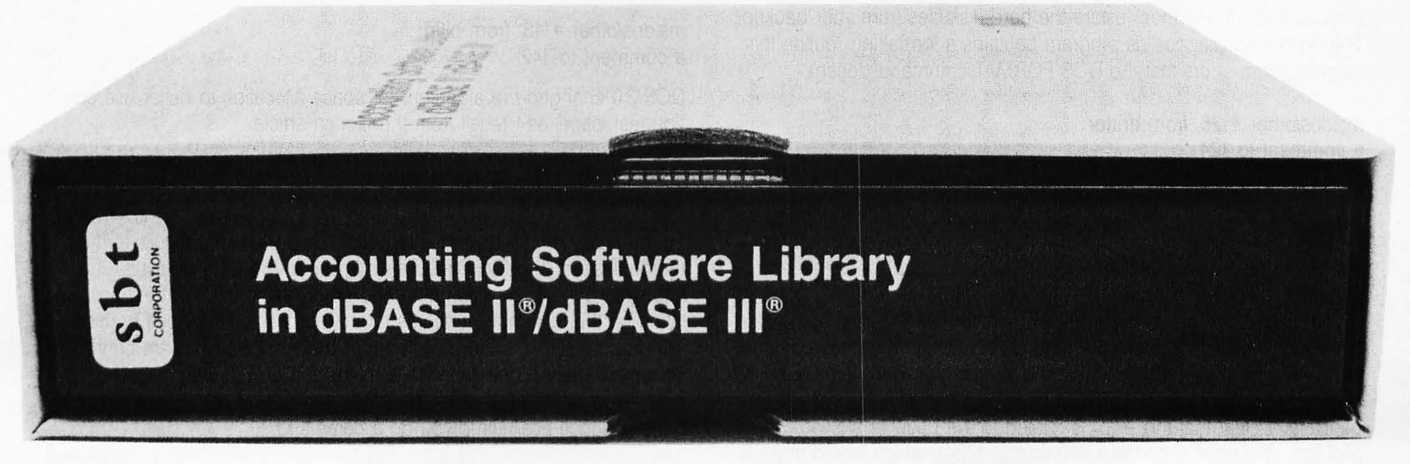
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Could it be disk directory thrashing, jumping back and forth between parts of a directory that is too large to be read in all at once? This might fit better than free space as an indicator, since I believe allocation is no longer sequential once files have been deleted and their clusters reused.

ms.dos/other #121, from tfritter:
a comment to 120

Don't think so; the symptom appears repeatedly during Turbo development. That is, a new file is created, an old one erased. Moreover, if I allow stuff to collect, I seem to get out of the area, and everything looks fine then. This is old-time MS-DOS 2.11, so I think allocation here is sequential (could be wrong, though). I'm also running 99 buffers, so the directory, at least, should be mostly in RAM (there will probably be a reload after Turbo terminates, but the symptom also appears during in-memory execution, so the only files created are text and overlays). The factor of 100 is, of course, an approximation. The delay is not just a casual burp; it seems to be on the order of 2 seconds. I imagined that this is the controller doing error correction.

ms.dos/other #122, from jimkeo:
a comment to 121

Don't know if there's a connection but I read somewhere that Turbo re-opens the overlay for each fetch (to keep the number of open files to a minimum). Are the overlay files in same directory?

ms.dos/other #123, from tfritter:
a comment to 122

Yes, I think so, but doubt connection. The big slowdown comes at end-of-edit (new text-file creation), not execution per se. And if I unload 1 megabyte or so from the drive, no problem, or if I let it load up (this would be approaching *full*), again, no problem. Probably I could learn how to command the controller to read and write sectors, then analyze errors, but in the process I would be stamping on my working drive—a little scary!

ms.dos/other #124, from barryn [Barry Nance]:
a comment to 123

The IBM Advanced Diagnostics program, as well as several public-domain programs, already provides for the kind of disk-error scanning that you refer to. Why don't you try the Advanced Diagnostics program and see what it says? If there are errors, I think your worst-case situation would be that you would have to reformat the disk in order to mark the bad sectors and then restore the hard-disk files from your backup. The Advanced Diagnostics program contains a formatting routine that catches some errors that the DOS FORMAT command doesn't.

ms.dos/other #126, from tfritter:
a comment to 124

I guess the main reason that I have not tried the IBM Advanced Diagnostics is that I don't have it. I have a Leading Edge machine, and I would not know what is in the IBM Advanced Diagnostics program that would be worth whatever effort would be required to locate and purchase a copy.

The diagnostics program with this machine (DIAGX) does do a hard-drive write/read test (apparently), and part of the time it does come up with an error on a particular track and sector. Not all the time, just sometimes; as likely as not, FORMAT will not find it. Moreover, it is not particularly clear that this error is related to the peculiar slowdown problem—the error is on track 610 (out of 1224), which would make it about halfway through allocatable storage, but the problem occurs somewhere around 2.8 megabytes free, which would seem to make it somewhere else.

It seems to me that the ability to access the collective experience of a large segment of power users is one of the advantages a network has over a magazine. If exposing my private problems to the world is inappropriate here, I would be glad to refrain.

ms.dos/other #128, from billn [Bill Nicholls]:
a comment to 121

It may not be a bad disk. Your BUFFERS = 99 is fine except when DOS has to look through them to find something. I recall a Peter Norton column in *PC Week* some time ago that recommended 8 buffers for a PC, 16 for a XT, and 32 for an AT, based on performance testing he had done. You may have too many buffers.

ms.dos/other #140, from bomb:
a comment to 119

Your problem seems twofold. First, jimkeo is right about nonsequential allocation of file space after files have been deleted. DOS will allocate on an as-needed basis, using the lower offset clusters first. If you wish to see how your files are linked, use the CHKDSK program included on your DOS disk.

Use the command line "CHKDSK *.*/V" to get the program to list all of the errors that it encounters (the switch /V) and to list all the files that are not stored in contiguous areas (the file spec *.*). I am sure that you will find quite a few of your files are spread all over the disk. (Note: Norton's Utilities shows a graphic view of how the files on your disk are allocated.)

If you COPY all your files to some other disk, reformat your hard disk, then COPY all your files back to the hard disk, those files will be contiguous. This will help speed up the loading of the large files.

As for setting your BUFFERS = 99, I have yet to see a situation that warrants that many buffers. As a rule of thumb, I set my buffers to match the amount of files that can be concurrently open. That is, if I have FILES = 20, then I set BUFFERS = 20; from that point it is simple to time my sessions and adjust the buffers accordingly.

ms.dos/other #142, from billbourn:
a comment to 140

I'm not so sure about contiguous allocation in DOS 3.0 and 3.1. I have seen some strange allocations of space for those releases of PC-DOS. Maybe the MS-DOS has a saner allocation algorithm.

ms.dos/other #143, from billn:
a comment to 142

DOS 3.0 changed the algorithm for space allocation to better use contiguous space, as I recall from the Norton article.

ms.dos/other #144, from billbourn:
a comment to 143

So the totally empty disk situation might give the same results to the reorganization. The funny results I mentioned are for a hard disk that has seen quite a few files come and go. I hate to think of the fragmentation on that disk now. It seems to me that the most serious problem with fragmentation is the placement of subdirectories that are on the command path. If one of those is misplaced or gets fragmented by overfilling one cluster's worth of entries, the access arm is going to grind a bunch every time you do a command.

(continued)

ms.dos/other #146, from rbrukardt [Randall Brukardt]: a comment to 121

DOS 2.11 (etc.) never keeps more than one 512-byte block of a directory in memory at one time, no matter how many buffers you use. That's the best reason for buying DOS 3.1, because it doesn't suffer from that stupid design. It makes a large difference for software that does a lot of directory searching (such as our Janus/Ada compiler); on the compiler, DOS 3.1 is almost 50 percent faster, all other things being constant.

ms.dos/other #148, from johnf [John Fistere]: a comment to 126

I don't think that you can correlate the track number with its usage with a certain level of memory usage. It will write to whatever empty areas it finds, depending on what has been deleted. Of course, if your disk is new, there is a correlation. The fact that your DIAGX program finds a bad sector part of the time correlates well with slow writing. Can you mark the sector with DIAGX?

ms.dos/other #149, from tfritter: a comment to 148

Yes, you are probably right. Even though disk storage is allocated in sequence, only free store can be reallocated. If, somehow, there is a lot of high-end store allocated, this would mean that the free store may be in the middle (low store is always gobbled first). I did not expect to see this in my case, since I rarely fill the disk over 8 megabytes, but I may have done so, and this may be the case; will try to check it out.

No, cannot mark the sector with DIAGX, nor with anything else I have, as far as I know. The problem is an annoyance; I would spend *some* money to fix it, but not a lot. I guess there probably are public-domain programs available to do this, and the best deal would be to get the source. Any such program would probably be free, but I would be more interested in reading the code, to see what they do, and maybe to extend it.

ms.dos/other #150, from barryn: a comment to 149

I recall seeing some public-domain disk utility programs on a variety of bulletin boards. I think the BYTEnet Listings node has quite a few, if memory serves. I haven't accessed it in a while. The number and communication parameters are as follows:

BYTEnet Listings   1 (617) 861-9764   1200-8-N-1

Although some of the material available in the Listings conference appears to have been copied from the BYTEnet Listings files, I think there a few files that haven't been copied. Until Listings becomes fully operational, it might be advantageous to look in BYTEnet for the kind of program you need.

ms.dos/other #184, from tfritter

The problem I have previously reported (a 2-second pause during *hard-drive* file store) does, indeed, turn out to have something to do with my original BUFFERS=99 command (as suggested by billn in message 128 and bomb in 140). Reducing BUFFERS to 10 or 20 *either solves* or hides the problem; BUFFERS=90 and 99 show similar results. Now, a *2-second* pause is a *long, long* time at computer speeds. Even a linear search of 100 buffers should be possible in milliseconds, not seconds. The Norton article on buffers was, in fact, the reason for choosing a large number; as I recall, the article did show that there is often an optimum number of buffers *for a particular program*. Above the maximum, there was some decrease in efficiency, due, we would expect, to buffer search time. But below the maximum, the cutoff was dramatic. It thus seemed reasonable to me that a large number of buffers would avoid dramatic inefficiencies, while accepting lesser inefficiencies for most programs. I think that so far the reasoning is valid. But there must be something else involved, because of the weird 2-second delay problem that I had with BUFFERS=90 or 99. This just cannot be a search. Maybe if they moved the contents of each buffer up one, for some reason. During this period the drive light is off—the problem is not a disk access. Anyway, the nuisance of the delay is gone, so I expect to let the puzzle rest as it is. Thanks to those who contributed suggestions, and to everyone else for putting up with my particular problem.

ms.dos/other #185, from bahama [Joe Galen]: a comment to 184

According to the PC-DOS 2.1 manual, pages 4-6, for most database applications, a value between 10 and 20 buffers will usually provide the best results. Beyond that point, the system may appear to start running slower. This is because with a very large number of buffers it can take DOS longer to search all buffers for the record than it would take to read the record from disk.

ms.dos/other #186, from tfritter: a comment to 185

The delay was 2 whole seconds! It doesn't take 2 seconds to search all the buffers. In fact, it shouldn't even take close to 50 msec, which would approximate the disk access time. There seems to be a small matter of 1.5-2 orders of magnitude here. I don't know—I guess one could write code to run that slow, but I think they probably would have to work at it.

ms.dos/other #188, from tfritter: a comment to 185

This actually would make sense if there were a lot more going on in BUFFERS than just caching. Suppose somebody thought it would be a good idea to *sort* the buffers? I guess this might make a convenient multisector disk write. Now suppose that the sorting algorithm used was a simple bubble sort (and that the data in each buffer would also have to be relocated); now *that* could take 2 seconds.

Of course, this is all mental vaporware. I have no more evidence than I ever did.

ms.dos/other #191, from cjackson [Craig Jackson]: a comment to 188

Actually, if one is writing more than a sector, DOS doesn't even put the full-sector portions of the write into the buffers, let alone use them for multisector work. Anyway, the buffer control information is stored next to the buffer.

ms.dos/other #192, from billn: a comment to 184

The second part of the problem may be due to directory and FAT updating. Does the problem happen as you open/close files? I got the impression from the Norton article that degradation got serious as buffers exceeded approximately 32 and was not a linear process. No doubt DOS 9.4 will address that problem.

ms.dos/other #193, from rbrukardt: a comment to 186

I often think Microsoft *did* work at making DOS slow. You have to think

(continued)

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FIBONACCI	*0:53.49*
30X30 MATRIX (8087)	*0:08.84*
FP OPERATIONS	*0:27.56*
FP OPERATIONS (8087)	*0:01.97*
SYNTAX CHECKING EDITOR	*YES*
MULTIPLE WINDOW EDITING	*YES*
EDITOR FILESIZE LIMIT	*MEMORY SIZE*
COMPILE ERROR CALLS EDITOR	*YES*
LINKER	*YES*
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DOS ACCESS FROM EDITOR	*YES*
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that they know more about timing issues than that. A program running under DOS 2.0 or later is supposed to let the operating system do its buffering for it, but I can often cut the run time of a program in half by adding buffering *routines*. That's not helping the programmer at all!

ms.dos/other #194, from leroy:
a comment to 190

When I was using a Compaq Plus (bought one when they first appeared), I had a problem with the thing *stopping* for a while in the middle of heavy disk activity. When I say a while, I mean between *5 and 10 seconds*. The machine would just stop dead, then continue as if nothing had happened. I was using 20 buffers, and adjusting the buffer size seemed to make no difference, so this is clearly a different problem. The pause would occur even while copying a file from one subdirectory to another.

ms.dos/other #196, from tfritter:
a comment to 194

I don't know, it could be the same thing. Maybe changing the buffers has just hidden the problem.

Stopping is right! Since I spend most of my computer time in Turbo Pascal, that is where I noticed it. It is real noticeable when the line count stops incrementing, the disk light is off, and this continues for several seconds. Then it would start again and complete okay. It was fairly common; I suppose it happened hundreds of times over the course of a few months. When I first started to notice it I assumed the problem had something to do with filling the disk to a level beyond what I normally run. But reducing the BUFFERS spec sure seems to either have solved it, hidden it, or reduced it to the extent that it is no longer a problem.

MACINTOSH

Discussions of the Macintosh this month cover file transfers, use of the Finder as an aid for the blind, multitasking capabilities, and projecting the Macintosh screen display. Information is posted on the Mac serial port, on programming the Mac to eject a disk, and one programmer's experience with debuggers on a 1.5-megabyte Mac.

PROJECTOR FOR THE MAC

macintosh/qanda #143, from frankb [Frank Boosman]

TITLE: Cinemascopemac?
I've read plenty on projectors for the Macintosh, but all of them presuppose a deep bank account. Is there a cheap, homegrown way to magnify the Mac's image large enough for a roomful of viewers? The quality doesn't have to be great or even good, just viewable.

As an example of the kind of thing I'm thinking of, would it be possible to align the upper half of an overhead projector with a Macintosh laid on its back, thereby projecting the screen image up?

macintosh/qanda #144, from lloeb [Larry Loeb]:
a comment to 143

Someone I know actually did lay his Mac over on its back and tried that. Burned up the power supply on it after 1 hour. There is a magnifying Fresnel lens that's not projection, but makes the image about two times larger. You can even make a holder for one you buy out of coathanger wire. *MacNifier* is a commercial product just along those lines, I believe. Other than that you may have to have deep pockets. Or wait for Apple to announce a Mac monitor.

macintosh/qanda #145, from ccrawfor [Chris Crawford]:
a comment to 143

It is possible to train a video camera onto a Mac screen and get a usable image. You could then feed the video into any number of video devices (large-screen TVs, for example). That is the quickest, simplest video interface.

macintosh/qanda #146, from dpallen [David Allen]:
a comment to 143

I have installed the Mentauris Technologies composite video adapter in my Macintosh, and it works very well. It provides a BNC connector on the back of the Mac. You connect this with any monitor that can handle a 21-kHz sweep rate and has a 20–30 MHz video bandpass. There are quite a few monitors that meet this specification, and Mentauris provides a full-page list of them, both CRT screens and projectors.

Mentauris costs about $200, and they can provide the special tools needed to get inside the Mac. No soldering is required, but you do have to drill a small hole in the Mac plastic case, very easy to do.

For more information, contact Mentauris Technologies, 1658 Interstate 35 S, POB 1467, San Marcos, TX 78667-1467.

FILE TRANSFERS

macintosh/qanda #175, from bbayer [Barry Bayer]

TITLE: Red Ryder Text Files
I have a problem with a text file received by Red Ryder. I know it is a perfectly good file, because I just uploaded it from the Compaq. (Simple, if sometimes expensive, way of file transfer between machines.) I use the Receive ASCII option on the Red Ryder File menu.

Reading it into MacWrite (with a carriage return signifying paragraph breaks), I get a small square at the beginning of each line. Presumably this stands for some sort of character, but I am not sure what. How do I get rid of this? Is there a filter on Red Ryder that I should set? (Removing them one at a time is just a little tedious. Help!)

macintosh/qanda #176, from lloeb:
a comment to 175

The square is a linefeed. You can strip all control characters with an option available under the Mode menu. This will also drop the CRs as well.

macintosh/qanda #177, from tom_thompson [Tom Thompson, Technical Editor, BYTE]

In reference to lloeb's message #176, he's correct that it's linefeeds. An alternative method in MacWrite is to cut one of the linefeeds, then paste it into the Find What input box under the Search menu. Leave the Change To box empty and click on Change All. This zaps every linefeed without obliterating the CRs in the file. *Warning:* Some people have had this technique crash the system, so work on a copy of the file. I've used this technique successfully with MacWrite and the MDS editor many times. Another alternative is Scott Waton's Didler program, which will selectively strip linefeeds (or add them) from a text file. It's fast, too. I have Red Ryder and Didler on one disk that I use to transfer source code between the Mac and the IBM-compatible machines here.

[Editor's note: The problem just discussed occurs with any text-file transfer between the Mac and an MS-DOS machine, regardless of the communications program. Both computers have different formats for

(continued)

text files, and linefeeds must be stripped or added to the file depending on destination machine.]

THE MAC AND THE BLIND

macintosh/software #97, from hbj [Henry Brugsch]

TITLE: Talking Software
I would like to start some discussion about the potentials for the development of Macintalk, specifically in terms of applications for blind users. Ever since the advent of the Mac, some blind users, myself included, have perceived *it as a threat.* Since the Mac relies upon user-driven icons instead of text from the keyboard to control applications, there is a tendency on the part of software manufacturers to develop software that is, naturally, screen-oriented.

Macintalk is one of the best speech software programs I have heard. But there is, as far as I know, no way for a blind user to interface with this tool. It will do a fine job with text files, clearly reading what is coming up on the screen. Yet, the blind user has no way of accessing the software, since there is no way of translating the icon into speech. Thus, some of us perceive the Mac as a real threat to the ability of users to benefit from new speech technology. This seems to be borne out by the fact there has been no development of a keyboard-driven speech program. I would like to see some comments on this subject and also invite members to come down to Handicapped conference and post some thoughts in the Speech topic.

macintosh/software #98, from lloeb: a comment to 97

You raise an interesting point in this. That the Finder itself handles the icon highlighting when selected indicates that is where the hook to call the speech routine must fall. I'm not sure that a cracked Finder with a Macintalk driver inserted isn't possible, you understand. But it would be *lots* easier if Apple was involved in it. It's their code.

MULTITASKING

macintosh/prod.discussn #177, from jamurphy [Joe Murphy]

I just received the software upgrade of my Thunderscan software, and the new version (2.7) allows multitasking with Switcher. It lets you scan a document in the background while you work in another program. It seems to work well; disk access and the clicking of the mouse, however, stop the scanning in the background. This is my first experience with multitasking and the Macintosh. Are there any other programs that multitask with Switcher? Anyone have any other experiences?

macintosh/prod.discussn #179, from rschnapp [Russell Schnapp]

All desk accessories have a certain amount of background processing capability. This is mostly at the mercy of the foreground (application) task. It's not the nicest form of concurrency, but a careful programmer can do neat things.

A trivial example of a background processing DA: the alarm clock. Also, check out *MacWait in* the Listings/Macintosh conference. It makes the hands on the waiting watch spin!

macintosh/prod.discussn #184, from deu [William Deu]

I was wondering, how do you like the resolution of your Thunderscan? Does it pick up details well?

macintosh/prod.discussn #187, from jamurphy

The new software gives you much better control over the scanning. I am very satisified with the resolution. It can only get text in a readable format by 300–400 percent enlargement of what you're scanning. That takes up a lot of memory and would not be practical on a 128K Mac. What is really neat is you can print the scanned document on a LaserWriter to get really nice results. The manual shows an example of a map scanned at 400 percent magnification and then printed at 25 percent reduction on a LaserWriter, giving a printed resolution of 288 dots/inch.

macintosh/hardware #25, from richard [Richard Shuford]

Fact and Opinion Concerning the Macintosh Serial Port
The serial port on the Apple Macintosh is not an implementation of the EIA's RS-232C standard, as are most other serial ports on microcomputers. The electrical characteristics of the Mac's port approximate the higher-speed RS-422A standard, but an RS-422A port is supposed to be wired according to a connection standard called RS-449. The Macintosh's port is not.

However, the Macintosh port seems to work okay according to its own odd setup, and with careful wiring it can be made to talk to devices that use an RS-232C interface.

The definitions of the serial-port pin-out from an early printing of *Inside Macintosh* are as follows:

Pin	Signal	RS-232C Interconnection Notes
1	frame ground	
2	+5 V	don't use this
3	signal ground	
4	TXD+	ignore pin 4
5	TXD−	use this as RS-232C TD (Transmitted Data)
6	power-on detect (+12 V)	can be used to provide Data Terminal Ready
7	HSK (handshake)	can be used somewhat like Clear To Send
8	RXD+	ignore pin 8
9	RXD−	use this as RS-232C RD (Received Data)

Several RS-232C/Macintosh interconnection schemes have been posted on various bulletin-board systems around the country. Some of them have been strange in some respect. I'm not necessarily saying that they do not work for the purpose for which they were wired, but that some unnecessary or illogical cross-connections were made in them.

USING SOFTWARE TO RESET THE MAC

macintosh/softw.devlpmt #2, from ccrawfor

Does anybody know how to get the system to cycle through a cold start? *Inside Macintosh* refers to system initialization procedures in its index, but these are in a manual that is not part of *Inside Macintosh*. My goal is to eject the disk on command and shut the system down, rather like the results of the Shut Down menu item in the new Finder. I've got the Eject function working fine but can't kill the system; it just asks the user to insert the disk again.

macintosh/softw.devlpmt #3, from callen [Chris Allen]: a comment to 2

The assembly for reboot on the Macintosh is quite simple: Take the ROM base, add 1C to it, then jump to that location. If the computer is a Lisa, you have to go into a little more involved process.

Or if you have Lisa Pascal 3.0 and a disassembler, make a program with one command, REBOOT, and disassemble it.

(continued)

P.S.: The JMP is legal Apple—they will not change it in future releases of the ROM.

DEBUGGER PROBLEMS

macintosh/softw.devlpmt #9, from ephraim [Ephraim Vishniac]

TITLE: Very Large Macs and RAM Disks
I'm currently working on RAM-disk software for two local (Boston area) companies that offer Mac memory upgrades past 512K. I've been beating my head against the wall on one particular problem: If I have a 1-megabyte RAM disk running in my 1.5-megabyte Mac *and* MacsBug is installed, the Mac heads west when the RAM disk goes past about half-full. If MacsBug isn't installed, all's well. Out of curiosity, I tested some other RAM disks. The Assimilation Process RAM disk doesn't blow up, but MacsBug is dead! (I press the interrupt switch and nothing happens.) The public-domain RamStart program also appears to kill MacsBug, but still blows up. The results suggest chance, not design.

Questions: Who out there has a Mac with >1-megabyte memory? What RAM disk(s) are you using? Ever try it with MacsBug?

Progress: I've been slowly crawling toward the exact point where the system dies. I *think* it croaks during a block move during a compaction of the application heap. I'm not sure yet, and I have no idea why.

macintosh/softw.devlpmt #12, from ephraim

After more investigation, I think the problem is most likely with MacsBug (I'm using Maxbug, actually, but close enough). I hope to confirm the diagnosis within a few days using a hardware emulator (how else to debug when the debugger breaks?), but my current belief is that MacsBug is relying on memory wraparound. That is, it writes/reads at some very high address, expecting that the data will wind up in real memory at some useful place. With a power-of-two memory size fully recognized by the system, that's probably a safe policy (although not a very good one). With an odd memory size, such as my 1.5-megabyte, that policy is a big loser.

Does the Levco upgrade have a 512K mode in which the system recognizes a half-megabyte and the rest is reserved for RAM disk? I would expect that configuration to have the same problem. If anyone wants to try this stunt at home, just boot from a disk with MaxBug installed (i.e., renamed to "MacsBug"), then start filling up your RAM disk. If you hit the problem, you'll know it. Symptoms vary, but are swift and fatal.

macintosh/softw.devlpmt #13, from ephraim

TITLE: MaxBug Bites Programmer, MacNosy to Rescue
While developing away on my 1.5-megabyte Mac, I found that I had system crashes when my 1-megabyte RAM disk reached about half-full *only with MaxBug installed.* Without MaxBug, no problems. I struggled with this problem for several days (Is it me? Is it hardware? Is it MacsBug?) and gradually became convinced that the problem lay with MacsBug.

Last week, I bought a copy of MacNosy, "the disassembler for the rest of us." (Note: *Apparently,* "the rest of us" use glass TTYs with bizarre command-line syntax and inscrutable abbreviations.) Happily, one of the sample MacNosy journals was a disassembly of the very same version of MaxBug I was wrestling with. The cause of the problem?

Read on.

MacsBug (and MaxBug and TermBug) assume:

— That wraparound provides reliable access to top-of-memory relative locations.
— That the world ends at 1 megabyte.

So, if you've got a Mac with more than 1 megabyte, MacsBug is not for you. Also, MacsBug will bomb if you've got a 1-megabyte Mac that doesn't map video to the top of memory but uses the additional memory solely for RAM disk.

The fix? I wrote an MS-BASIC (gasp!) program (below) that filters a copy of MaxBug, looking for certain addresses. The output of the filter has these addresses patched to other, hardware-dependent values. But at least I have a version that works on my machine.

```
' Program to patch up MacsBug
' Ephraim Vishniac    October 2, 1985
' Send BIX mail to "ephraim"
' Send Usenet mail to decvax!wanginst!vishniac

' MacsBug addresses its variables as though the Mac had
' 1-megabyte memory and relies on wraparound to fix things up.
' These are bad assumptions on >1-megabyte Macs and on
' 1-megabyte Macs operating in 512K mode. This program takes
' an original copy of MacsBug and creates a version that expects
' some different memory size. This program has been tested using
' MaxBug and a 1.5-megabyte Mac. To adapt this program for
' your memory size, alter the line that defines the string named
' "Replace$."

SourceFile$ = FILES$(1,"????")
IF SourceFile$ = "" THEN END
OPEN "I", #1, SourceFile$
DestFile$ = FILES$(0,"Output file name?")
OPEN "O", #2, "Temp MacsBug"
PRINT "Converting "SourceFile$" to "DestFile$

' Test$ is set to the 16-bit value $000F. This is used to detect
' the high word of possible offending addresses.
Test$ = CHR$(0) + CHR$(15)
' Replace$ is set to the 16-bit value $0017 (for 1.5-megabyte
' memory). When an offensive address is detected, Replace$ is
' substituted for its high-order word.
' *****Change the next line to fit your real memory size! *****
Replace$ = CHR$(0) + CHR$(23)

' Within the following loop, we search for 4-byte sequences of the
' form $000FAxxx. Because of alignment constraints, we only
' have to test on word boundaries, not at every byte.

' Start the pipeline.
x$ = INPUT$(2,#1)
Gotten = 0 : 'Number of addresses patched

WHILE NOT(EOF(1))
    y$ = INPUT$(2,#1)
    IF (x$ = Test$) AND ((ASC(LEFT$(y$,1)) AND &HF0) =
&HA0) THEN x$ = Replace$ : PRINT "Got one!"
: Gotten = Gotten + 1
    PRINT #2,x$;
    x$ = y$
WEND

' Flush the pipeline
PRINT #2,x$;

CLOSE #1
CLOSE #2

NAME "Temp MacsBug" AS DestFile$,"????"
PRINT "Conversion done."
PRINT Gotten" patches made." ■
```

Program faster, debug faster.

Table of Contents

C with Structure Outlining

Index/Cross Reference

Source Print™
Source Formatting Utility
For C, Pascal, BASIC, dBASE II, III, III+, Modula-2

Everything you'd expect...

Index/Cross reference. This is particularly useful for locating identifiers in source listings when you are away from your editor; *SOURCE PRINT*™ can list line and page numbers of all occurrences for each alphanumeric identifier.

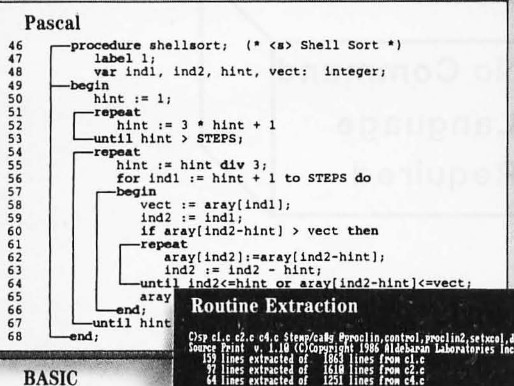
Page headings and line number. SOURCE PRINT gives you page headings which include current and file date/time, page number, and source line-number range. Lines may be numbered if desired.

Table of contents. You may imbed titles and subtitles in your source text; SOURCE PRINT can then generate a table of contents. Titles and subtitles will also appear on page headings.

Automatic indentation. SOURCE PRINT can automatically indent source listings based on control-structure nesting. For Pascal and Modula-2, indentation is also based on procedure and module nesting.

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Pascal

```
──procedure shellsort;  (* <s> Shell Sort *)
     label 1;
     var ind1, ind2, hint, vect:  integer;
──begin
     hint := 1;
   ┌─repeat
   │    hint := 3 * hint + 1
   └─until hint > STEPS;
   ┌─repeat
   │    hint := hint div 3;
   │    for ind1 := hint + 1 to STEPS do
   │  ┌─begin
   │  │     vect := aray[ind1];
   │  │     ind2 := ind1;
   │  │     if aray[ind2-hint] > vect then
   │  │  ┌─repeat
   │  │  │     aray[ind2]:=aray[ind2-hint];
   │  │  │     ind2 := ind2 - hint;
   │  │  └─until ind2<=hint or aray[ind2-hint]<=vect;
   │  │     aray
   │  └─end;
   └─until hint
──end;
```

Routine Extraction

```
C>sp c1.c c2.c c4.c $temp/ca8g @proclin,control,proclin2,setxcol,dobold
Source Print  v. 1.10 (C)Copyright 1986 Aldebaran Laboratories Inc. 11732
    159 lines extracted of   1863 lines from c1.c
     97 lines extracted of   1610 lines from c2.c
     64 lines extracted of   1251 lines from c4.c
```

BASIC

```
10  REM ***** <s> She
20   H = 1
30   H = 3 * H + 1
40   IF H <= N THEN GOTO 30
50   H = INT(H / 3)
60   FOR I = H + 1 TO N
70       V = A[I]  :  J = I
80       WHILE A[J - H] > V
90           A[J] = A[J - H]
100          J = J - H
110          IF J <= H THEN GOTO 130
120      WEND
130      A[J] = V
140  NEXT I
150  IF H <> 1 THEN GOTO 50
```

Program structure outlining. SOURCE PRINT can draw lines to connect the beginning and end of nested control structures. Even complex structures stand out clearly.

Key words emphasis. Emphasize key words in your programming language with styles your printer supports: boldface, underline,...

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NEW SYSTEMS

Transportable from Bondwell

The Bondwell 18 is a transportable computer that runs on a 4.77-MHz 8088 microprocessor and is compatible with the IBM PC. It comes with 512K bytes of RAM, two 5¼-inch double-sided double-density floppy-disk drives, a keyboard, and a built-in 9-inch monochrome monitor with a resolution of 640 by 200 pixels.

Also included is an RS-232C and a parallel port, standard 9-pin RGB output and composite color output, a real-time clock, and a 110/220-volt power supply.

The Bondwell 18 comes with MS-DOS 2.11 and GW-BASIC. It weighs 29 pounds and, according to the company, is smaller than comparably equipped transportable computers.

The suggested retail price for the Bondwell 18 is $1295. For more information, contact Bondwell, 3300 Seldon Court #10, Fremont, CA 94539, (415) 490-4300.
Inquiry 564.



The Bondwell 18 transportable computer.

Corona's AT-Compatibles

The Corona ATD is based on an 8-MHz Intel 80286 microprocessor with no wait states and is compatible with the IBM PC AT. The ATD's motherboard also includes a floppy-disk-drive controller, a parallel and serial port, a socket for an 80287 floating-point coprocessor, and 640K bytes of RAM.

Three models are available: The ATD-8-Q comes with a 1.2-megabyte floppy-disk drive. The ATD-8-Q20 has a 1.2-megabyte floppy-disk drive, a 20-megabyte hard-disk drive, and an AT-compatible hard-disk controller. The ATD-8-QT40 has a 1.2-megabyte floppy-disk drive, a 40-megabyte hard-disk drive and controller, and a 60-megabyte streaming-tape backup drive.

All models are equipped with a 14-inch monitor with 640- by 400-pixel graphics resolution or 640- by 200-pixel resolution in emulation mode. A color/monochrome graphics card lets you add a color monitor to the system.

Other standard features include four AT-compatible and two PC-compatible expansion slots, a real-time clock/calendar, a 130-watt switch-selectable power supply, and an AT-compatible detachable keyboard. All models come with MS-DOS 3.1 and GW-BASIC 3.1. Suggested list prices are $3995 for the ATD-8-Q, $5495 for the ATD-8-Q20, and $8995 for the ATD-8-QT40. Contact Corona Data Systems Inc., 275 East Hillcrest Dr., Thousand Oaks, CA 91360, (805) 495-5800.
Inquiry 565.

Multiuser Computer from Eagle

Eagle Computer's multiuser computer, the Concorde, is compatible with the IBM PC AT and VME/VMX 32-bit systems. The Concorde is based on an Intel 8-MHz 80286 microprocessor with no wait states. Each processor board comes with 1 megabyte of memory, a keyboard port, color monitor port, and an RS-232C port.

The Concorde runs the Pick operating system and supports up to 16 users. It has 12 AT-compatible and 12 VME-compatible expansion slots for additional processor boards, device controllers, and memory-expansion boards. The system supports most major device controllers, including the IBM PC AT ST506/ST412 and SA400 standards, QIC-02 and QIC-36 tape interfaces, and SMD and SCSI standards. You can install up to eight 5¼- and 8-inch drives in the system cabinet and upgrade the power supply to 1250 watts with add-on modules.

The base model with one 80286 main processor board, 16 serial ports, one 1.2-megabyte 5¼-inch floppy-disk drive, one 140-megabyte (unformatted) hard-disk drive, one 60-megabyte tape-cartridge drive, and the Pick operating system will sell for between $25,000 and $30,000. For more information, contact Eagle Computer Inc., 7100 Chapman Ave., Garden Grove, CA 92641, (714) 891-2665.
Inquiry 566.

PERIPHERALS

Drives for the Mac Plus

LoDOWN recently introduced a series of hard-disk drives and tape backup systems for the Macintosh Plus. Available with storage capacities of 10, 20, 40, or 80 megabytes, the hard-disk drives support Apple's enhanced system software, which provides larger volume sizes, more files per volume, hierarchical file management, and faster speed.

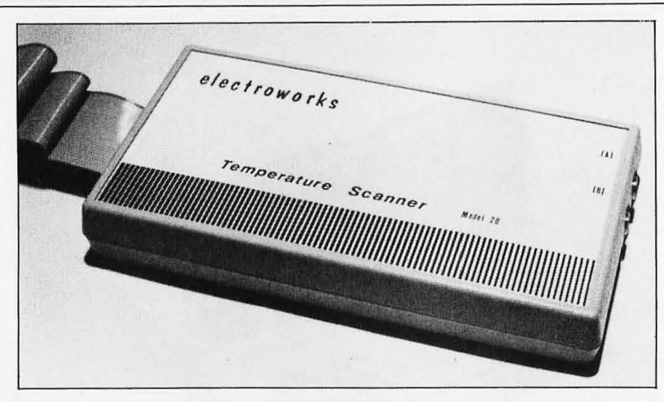
Two tape backup systems are available. A cassette unit uses 22-megabyte tape cartridges, while a standard ¼-inch DC600A unit uses 60-megabyte tape cartridges. Both systems back up or restore a 20-megabyte hard disk in 4 minutes and work with Apple's Hard Disk 20, LoDOWN's hard disks, General Computer's Hyperdrive, and others.

You can connect up to eight LoDOWN hard disks

(continued)

PERIPHERALS

and tape backup systems to a Macintosh Plus through the SCSI port on the computer's back panel. The 10-megabyte hard-disk drive costs $795; the 20-megabyte, $995; the 40-megabyte, $1995; and the 80-megabyte, $3995. The T20 tape backup system is $895, and the T60 version, $1795. For more information, contact LoDOWN, POB 5146, Pleasanton, CA 94566, (415) 426-1747.
Inquiry 567.



Electroworks' Model 20 Temperature Scanner.

Excelsior RAM-Cache Disk Drives

Computer Products International has introduced the Excelsior line of disk drives, available in hard-disk and removable-cartridge versions, as well as in configurations that include both. The Excelsior drives support up to 48 megabytes of storage on removable cartridges and up to 360 megabytes on hard disks.

Designed to provide greater access speed, the drives use a RAM-cache disk controller incorporating a disk-caching algorithm that stores the most frequently used data in the controller's 256K-byte RAM buffer. The data is subsequently accessed at RAM speeds rather than at disk speeds. The average access time for the hard disk can be as low as 33 milliseconds, and for the removable cartridge, 85 milliseconds; maximum transfer rate is 570K bytes per second.

The Excelsior drives are available with 12 to 360 megabytes of hard-disk capacity and 12 to 48 megabytes of removable-cartridge capacity. Prices start at $1795 for a 12-megabyte hard-disk drive. A 24-megabyte hard-disk and 12-megabyte removable-cartridge system costs $3495.

The drives are available for the IBM PC and compatibles, NEC APC, Epson QX-10, Victor 9000, Apple, Apricot, and other personal computers. Adapter boards for these computers sell for $300 each. Contact Computer Products International Inc., 740 South Hillview Dr., Milpitas, CA 95035, (408) 945-0100.
Inquiry 568.

Temperature Scanner for Commodores and Apples

Electroworks' Model 20 Temperature Scanner for the Commodore 64 and Apple IIe computers measures temperatures from −20°C to +100°C with an accuracy of ± 0.5°C. The scanner is equipped with two solid-state temperature sensors and two input channels that are software selectable. You can program the computer to display temperatures in Fahrenheit or Celsius, record temperatures at predetermined intervals, set audible alarms for high and low limits, and display and record the temperature differential between the two sensors.

The Model 20 scanner sells for $179. Contact Electroworks, Building One, Brown Rd., Cornell Research Park, Ithaca, NY 14850, (607) 257-1344.
Inquiry 569.

Sharp's 256-Color Ink-Jet Printer

Sharp's JX-720 color ink-jet printer can produce up to 256 colors and is designed for printing business-presentation graphics, CAD/CAM drawings, and other color images. The JX-720 prints text at 35 characters per second and a full-page 1024- by 1024-dot image in 2.2 minutes. Standard resolution is 120 dots per inch. With graphics software, you can adjust the resolution to produce halftone images up to 8½ inches wide.

The JX-720 has four ink cartridges—yellow, cyan, magenta, and black. The printer is equipped with a Centronics parallel interface and an automatic print-head cleaner designed to minimize problems with nozzle clogging. The JX-720 can print images on 8½- by 11-inch cut sheets, overhead projector transparencies, and roll paper.

Suggested list price for the JX-720 is $1495. For more information, contact Sharp Electronics Corp., Systems Division, 10 Sharp Plaza, Paramus, NJ 07652, (201) 599-3856.
Inquiry 570.

High-Speed Dot-Matrix Printer

The NP-2410 dot-matrix printer from Nissho Information Systems produces near-letter-quality text at 180 characters per second (cps) and draft-quality text at 300 to 540 cps, depending on pitch. The printer comes with a modular RS-232C or Centronics parallel interface and emulates the Epson LQ-1500 printer. Standard features include a 6K-byte buffer, friction feed, rear and bottom feed, and single-sheet feed.

The NP-2410 has three resident letter-quality fonts—Courier, Letter Gothic, and Century—and four resident draft-quality fonts. You can supplement these with additional fonts, including Prestige, Script, and OCR A and B, available on cartridges.

With a standard modular interface, the NP-2410 sells for $1845. An optional 48K-byte buffered interface costs an additional $150. Font cartridges cost $60 each. Contact Nissho Information Systems, 3838 Carson St., Suite 105, Torrance, CA 90503, (213) 543-1885.
Inquiry 571.

(continued)

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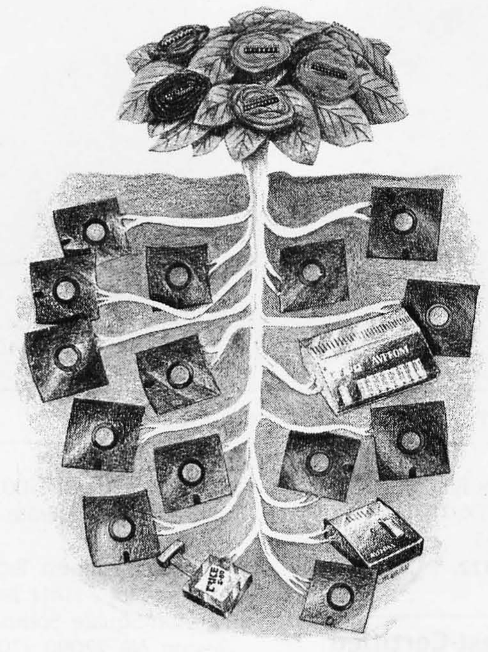
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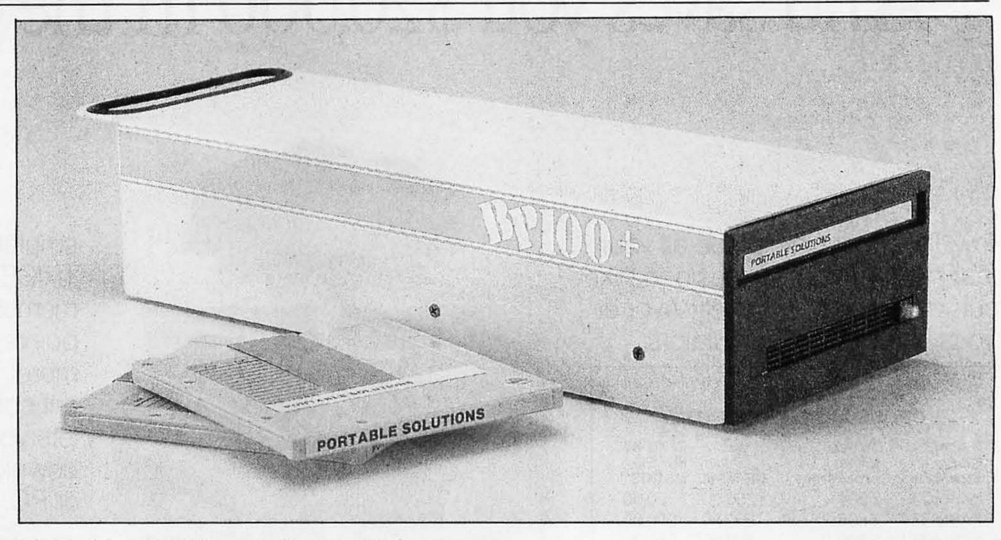
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PERIPHERALS

Portable Optical-Disk Drive for PCs



The BackPac BP-100+ portable optical-disk drive.

The BackPac BP-100+ from Portable Solutions is a portable optical-disk drive for IBM PC, XT, AT, and compatible computers. The drive reads removable, write-once laser disks with a minimum of 115 megabytes of formatted storage capacity. The drive's read-data rate is 10 megabytes per minute, and its data-transfer rate is 2.5 megabits per second. The average access time is less than 200 milliseconds, and the read error rate is 1 bit per 10^{12}.

The BP-100+, which weighs 7 pounds, comes with three laser disks, each of which is encased in a hard plastic cartridge equipped with a built-in write-protect switch. The drive also comes with three Adaptacon plug-in boards, which provide power and interface connections for three computers and fit into short expansion slots. The BP-100+ is bundled with Survival software, a collection of utilities for backing up and restoring files.

The drive sells for $4995. Additional LitePac 330 optical disks cost $100 each, and additional Adaptacon boards cost $99 each. For more information, contact Portable Solutions Inc., 1701 Directors Blvd., Suite 250, Austin, TX 78744, (512) 448-4965.
Inquiry 572.

Tempest-Certified Printers

Tempest Technologies has introduced daisy-wheel and line printers that meet the U.S. Government's Tempest security standards.

The DWP5155SQ daisy-wheel printer, which operates at 45 characters per second, costs $4500. Two line printers are available: The LPM5300XQ, a 300-line-per-minute model, costs $9950; the 600-line-per-minute LPF5600XQ is $11,500. All three printers operate at less than 55 decibels.

Contact Tempest Technologies Inc., 11411 Isaac Newton Square South, Reston, VA 22090, (703) 471-0157.
Inquiry 573.

Low-Cost Modem with Phone

The JC-1200A is a 1200-bps modem from Theall Engineering that includes a built-in telephone for voice communications. The unit's tone-sensing circuit detects carrier and voice signals and automatically passes the signals to the computer or phone. The JC-1200A is Hayes-compatible and features auto-dial, auto-answer, auto-redial, and compatibility with Bell 103 and 212A standards.

The unit has a built-in speaker and clock/calendar that lets you track the length of calls on screen. Battery backup stores the time and phone numbers while the power is off.

The JC-1200A connects to computers through an RS-232C port and costs $289.95. Contact Theall Engineering Co., POB 167, Oxford, PA 19363, (215) 932-3488.
Inquiry 574.

ADD-INS

Data-Acquisition Board from Data Translation

Data Translation's DT2821-F is a data-acquisition board compatible with the IBM PC AT. The board is designed for waveform, vibration, speech, particle analysis, and other applications that require high-speed data acquisition. It has an A/D rate of 130 kHz and provides 12-bit resolution for 16 single-ended or 8 differential analog inputs, programmable gain, a programmable clock, and support for interrupts and DMA transfers. Sixteen digital I/O lines are standard.

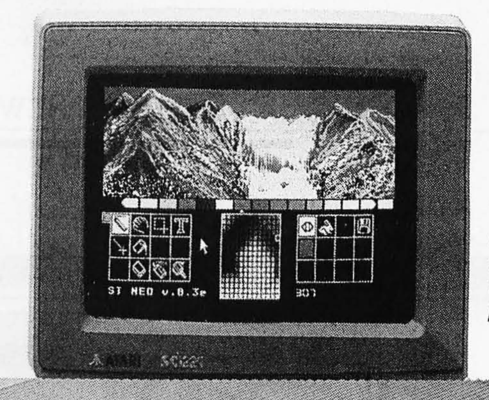
A/D sampling is controlled by a channel-gain list RAM that lets you sample input channels in any sequence and at any gain. The board uses two DMA channels on the IBM PC AT and switches between the two to provide continuous performance. Analog output is provided by two 12-bit independent deglitched digital-to-analog converters with a throughput of 130 kHz each.

The optional ATLAB software package contains a library of subroutines designed for the DT2821-F. List price for the board is $1595; ATLAB costs $449. Contact Data Translation Inc., 100 Locke Dr., Marlboro, MA 01752, (617) 481-3700.
Inquiry 575.

(continued)

Atari Explodes

Atari's new computer serious threat to Macintosh. Will the Amiga survive?



The Atari 520 ST is a serious challenge to the Apple Macintosh and will open up a major fight in the personal computer market.



By Joseph Sugarman

Imagine this. If I could offer you a Macintosh computer—(a computer that sells for over $2000)—for one third the price, you might wonder.

But what if I offered you a better computer with none of the disadvantages of the Mac and what if I added new features which improved its speed and performance? That's exactly what Atari has done in an effort to grab the ball from Apple and really explode into the personal computer market.

HEADING EFFORT

Heading the effort at Atari is Jack Tramiel—the same man who built Commodore into a billion dollar corporation, sold more computers than any other man in the world and believes in giving the consumer incredible value without sacrificing quality. The new Atari is a perfect example.

First, let's compare the new Atari ST to the Macintosh and the Commodore Amiga. Sorry IBM, we can't compare the ST to your PC because yours is almost five years old, much slower, and, in my judgement, over priced.

Price The cheapest you can get the Macintosh with 512K of memory is $1800 with a one-button mouse, a disk drive and a monochrome monitor. The Amiga sells for $1995 with a two-button mouse, a disk drive and a color monitor. The Atari ST sells for $699 with a two-button mouse, a disk drive and a monochrome monitor and for $200 more, a color monitor. Read on.

Monitor With the Mac you can only use its 9" monochrome monitor and with the Amiga you can only use its 12" color monitor. With the ST you have a choice of either a 12" monochrome or high-resolution color monitor or your own TV set.

Resolution The number of pixels or tiny dots on a screen determine the sharpness of a computer monitor. The Mac has 175,104 pixels and has one of the sharpest screens in the industry. The Atari ST has 256,000 pixels or almost a third more than the Mac. And the Atari color monitor compared to the Amiga in its non interlace mode is 128,000 pixels or exactly the same.

Power All the computers have a 512K memory with a 68000 CPU operating with a 32-bit internal architecture. But Atari uses four advanced custom chips which cause the CPU to run faster and more efficiently giving it some tremendous advantages. For example, it has a faster clock speed of 8Mhz compared to the Mac's 7.83 and the Amiga's 7.16. And the speed of the unit is hardly affected by the memory requirements of the monitor which in the Amiga can eat up much as 70% of the unit's cycle time or speed.

Keyboard This is the part I love. The Mac has a small 59-key keyboard and a mouse. That's all. The 95-key Atari has both a mouse, cursor keys, a numeric keypad and ten function keys. The keyboard looks fantastic and is easy to type on. Although the 89-key Amiga has almost all the features of the Atari keyboard, it looks like a toy in comparison. (Sorry Commodore, but that's my opinion.)

Disk Drive The Mac's 3½" disk drives run at variable speeds—slowing down as they run. The Atari 3½" drives run faster at a constant speed—and quieter than any other unit.

Features The Atari ST comes equipped with the same printer and modem ports as the IBM PC—a parallel and RS232C serial port. The Mac comes only with a tiny non-standard serial and modem port. The ST has a hard disk interface capable of receiving 10 million bits per second. There are two joy stick ports and a 128K cartridge port for smaller programs or games. It has 512 colors (for the color monitor), it has a unique MIDI interface into which you can plug your music synthesizer and record or play back your music.

Software Right now, the Mac has more than the Atari ST and the Amiga combined. The Atari is a new system but the track record of Atari's Jack Tramiel and the potential of the new unit is causing a flood of new software titles. In fact, I'll predict that eventually the Atari will have more software than the Mac. There are now hundreds of titles, from word processing to spread sheet programs, from graphics and games to data base management—all with those easy drop-down menus and windows. There's plenty from which to select now and plenty more to come.

If you think I'm enthusiastic over the ST, listen to what the press is saying. *Creative Computing* exclaimed, "Without question, the most advanced, most powerful micro computer your money can buy." and finally, the Atari ST is the best selling computer in Europe and acclaimed, "The computer of the year," by the European personal computer press.

I am going to make the ST so easy to test in your home or office that it would be a shame if you did not take advantage of my offer. First, I will offer the computer itself for only $299. You will need, in addition, either one or two disk drives and either an Atari monochrome or color monitor or your own TV. If you order with your credit card during our introduction I will ship your order and only bill you for the postage and 1/3 the purchase price. I will also add a few software packages free including "Logo"—a beginners programming language, a disk for programming in BASIC and Neochrome—a graphics paint program.

COMPARE THE TWO

After you receive the Atari ST, put it next to your Mac or Amiga or even IBM. See how extremely sharp the graphics appear, discover what a perfect word processor it is, how great the keyboard feels and finally how much faster and quieter it runs.

If you're not convinced that the Atari is far superior to your present computer and a fantastic value, simply return it and I'll refund your modest down payment plus our postage and handling charges. If you decide to keep it, I'll bill your credit card account for the remaining balance and enroll you in our discount software club (a $50 value) that lets you buy software for up to 50% off the retail price.

But act fast. We have only 2,000 units and 1,000 free memberships that we will offer as part of this introductory program and we are certain they will go fast. Order today.

To order, credit card holders call toll free and ask for product by number (shown in parentheses). Please add $20 per order for postage and handling. (If you pay by check, you must pay the full amount but we will provide you with a bonus software package.)

ST Keyboard & CPU (4060BY) **$299**
Disk Drive (4056BY) **199**
Monochrome Monitor (4057BY)...... **199**
RGB Color Monitor (4058BY) **399**

Note: A list of software will come with the unit.

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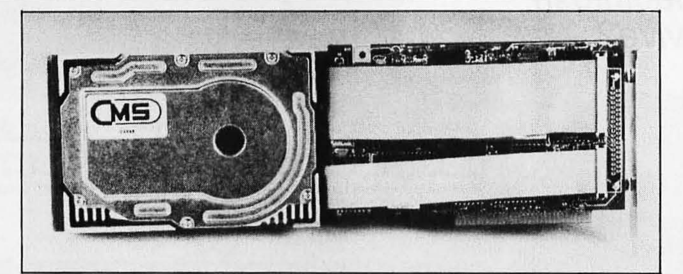
ADD-INS

CMS's Internal Hard Disks

CMS has introduced the Drive Plus 20-megabyte internal hard-disk drives for the IBM PC XT and compatible computers. Several models of the disk drives are available: One version has an SCSI, the second has an ST506 interface, and the third has an ST506 interface and is ruggedized for use with portable computers.

Each Drive Plus fits in a full-sized expansion slot in the IBM PC XT. The ST506 models have a data-transfer rate of 5 megabits per second, and the SCSI model, 7.5 megabits per second. The drives will also run in the IBM PC and compatibles with upgraded power supplies.

Suggested list prices are $995 for the standard ST506 drive; $1159 for the ruggedized ST506 drive; and $1239 for the SCSI drive. Prices include adapter boards and controllers. For more information, contact CMS Inc., 401-B West Dyer Rd., Santa Ana, CA 92707, (714) 549-9111.
Inquiry **576.**



Drive Plus 20-megabyte internal hard-disk drive.

MDL-22 Data Logger

The MDL-22 plug-in board for the IBM PC and compatible computers lets you monitor, control, and report real-time events. The board also works as a stand-alone data logger. Standard features include 22 8-bit analog inputs, 16 digital I/O lines, a DB-25 serial port for RS-232C or 20-mA current loop communications, a DB-25 parallel port, and a battery-backed clock. A piggyback switching power supply and 40-column printer are optional.

The MDL-22 sells for $159. The optional power supply is $45. For more information, contact The Automation Group Inc., 848-0 Nandino Blvd., Lexington, KY 40511, (606) 252-6753.
Inquiry **577.**

Chromatography Board for the IBM PC

MetraByte's CHROM-1 is a data-acquisition board that plugs into an expansion slot inside the IBM PC. The board has four software-selectable input ranges, a +1.000 volt reference for calibration, two software-selectable input channels, and 1000 volts of optical isolation. It also has four opto-coupled digital inputs and two double-throw, double-pole relay outputs.

The CHROM-1 board comes with a data-acquisition and display software package with no anaylsis capabilities. The software lets you set sample rate, test duration, input range, and other functions from a menu, and it can create ASCII files that you can download to other software for analysis. The optional CHROM+ software package provides a results report with peak area, peak start, peak end, peak maxima, and other factors.

The CHROM-1 board costs $595; the CHROM+ software costs $995. For more information, contact MetraByte Corp., 254 Tosca Dr., Stoughton, MA 02072, (617) 344-1990.
Inquiry **578.**

Smartek Board Plugs into IBM PC AT

The Smartek 1 Mega Byte System Board is based on an Intel 6-MHz 80286 microprocessor that also operates at either 8 or 10 MHz. The board comes with 1 megabyte of parity-checked RAM, eight expansion slots, a socket for an 80287 math coprocessor, three programmable counter/timers, 7-channel DMA, and 16 levels of system interrupts.

The 12- by 13.8-inch board can be mounted in the PC AT or compatible chassis and, according to the company, is fully compatible with the PC AT. No selection jumpers are required for system configuration.

The Smartek-1 runs at 6 or 8 MHz and costs $1295; the Smartek-2, which runs at 6 or 10 MHz, costs $1495. Both boards are also available with no-wait-state memory for an additional $300. For more information, contact Smartek Inc., 2000 Wyatt Dr., Suite 3, Santa Clara, CA 95054, (408) 988-4112.
Inquiry **579.**

Image Digitzer from Genoa Systems

The Capture plug-in board from Genoa Systems is an image digitizer for the IBM PC, XT, AT, and compatible computers. The board captures an image from a standard RS-170 video input, such as a camera, and stores the captured frame in on-board memory. You can simultaneously display the image on a monitor or print it on a standard graphics printer.

You can use the software bundled with the board to enhance the image by editing, binary thresholding, and filtering. Other capabilities include zoom, text on overlay, selective shading, cutting, and combining with previous pictures.

The Capture board supports a display resolution of 512 by 512 pixels with 64 colors. The digitization rate is 1/30 second per frame. An output table of four 256K by 8-bit hookup tables is standard. Options include piggyback boards for memory expansion, pseudocolor display, and an RGB hookup table of three 256K by 8 bits.

The board's suggested retail price is $1495. Contact Genoa Systems Corp., 73 East Trimble Rd., San Jose, CA 95131, (408) 945-9720.
Inquiry **580.**

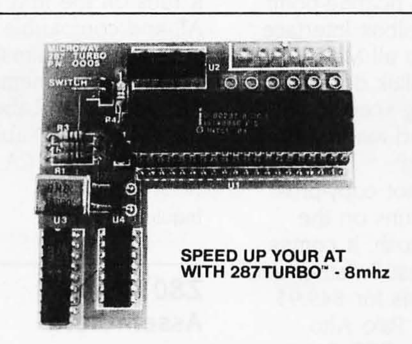
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Multitasking for C

Multi-C is a library of C and assembly-language functions from Cytek that let you incorporate multitasking within programs. Designated functions become tasks that can schedule other tasks, communicate with each other using queues and flags, and use almost all standard C functions. The software supports interrupt handlers.

Multi-C is available for Lattice's and Computer Innovations' 8086 C compilers and Paragon's Z80 C cross compiler. The software runs on the IBM PC and compatible computers and sells for $149. For more information, contact Cytek Inc., 805 Turnpike St., Unit 202, North Andover, MA 01845, (617) 687-8086.
Inquiry 581.

Fundamental BASIC from Philon

Henry's Fundamental BASIC is a simplified version of BASIC from Philon. It includes such features as a library of predefined functions; multiple-line, user-defined functions; support for a math coprocessor; double-precision math; and some FORTRAN functions. You can also call text editors and system utilities from within the interpreter.

Henry's Fundamental BASIC is a subset of Philon Fast/BASIC-M, a more advanced compiler. Priced at $49, versions are currently available for the IBM PC and compatibles, Atari 520ST, and Commodore Amiga. A minimum of 128K bytes of memory is required. Contact Philon Inc., 641 Avenue of the Americas, New York, NY 10011, (212) 807-0303.
Inquiry 582.

Program Generator for Turbo Pascal

Zeus, a program generator from JMC Research, works with Borland International's Turbo Pascal to let you generate database programs, write reports, and build menus. You build a menu-driven database program by drawing the input screen layout and naming the variables and their types. With minimum system requirements, you can build programs with a maximum of 300 fields per record and 80 characters per field.

The program includes a similar utility for writing reports. The menu builder lets you input multiple programs to execute with a single keystroke. These programs need not be written in Pascal.

Zeus runs on IBM PCs and compatibles, requires a minimum of 128K bytes of RAM and an RGB monitor, and costs $59.95. A hard-disk drive is recommended. Contact JMC Research Inc., 803 Eisenhower Dr., Augusta, GA 30904, (404) 736-8265.
Inquiry 583.

Multitasking FORTH for the Mac

Designed for developing multitasking Macintosh applications, Mach1 from Palo Alto Shipping is a 32-bit version of FORTH-83 that the company claims is twice as fast as other FORTH applications. The program uses local variables and named input parameters for recursion, a standard Motorola assembler, a symbolic debugger, and normal text files from any editor, including MacWrite.

Other features include the 80-bit SANE floating-point library, a Toolbox interface for access to all Macintosh traps, MacinTalk drivers for programming speech, vectored I/O, and loading from the clipboard.

Mach1 is not copy-protected and runs on the 512K Macintosh. It comes with the latest Switcher and Edit programs for $49.95. Contact The Palo Alto Shipping Co., POB 7430, Menlo Park, CA 94026, (415) 854-7994.
Inquiry 584.

Structured Printing Aid

Aldebaran Laboratories' Source Print is a utility program that formats printouts of source code written in C, Pascal, BASIC, and dBASE II and III. Designed to show a program's structure at a glance, Source Print draws lines that indicate nesting, indents the code based on nesting levels, and prints reserved words in boldface type.

Source Print's "library" function lets you insert titles and subtitles in a source file, usually within comment statements. The program tracks which file contains which subtitle and lets you select up to 40 subtitled functions or procedures from 1 to 16 files to form a new source file. The program also prints page headings that can include the filename, date and time, titles, subtitles, and page numbers. You can use these headings to print only the parts of files you designate.

Source Print sells for $97. It runs on the IBM PC, XT, AT, and compatible computers and requires at least 128K bytes of memory. Contact Aldebaran Laboratories Inc., 3738 Mt. Diablo Blvd., #312, Lafayette, CA 94549, (415) 283-7084.
Inquiry 585.

Z80 Cross Assemblers

Two programs for assembling Z80 code on an IBM PC are available from United States Software Corp. AX Z-80, an absolute version, translates an assembly-language source file to a downloadable object file in Intel hexadecimal format. RX Z-80, a relocatable version with a linker, translates an assembly-language source file to a relocatable file. You can then link the file with other relocatable files to form a downloadable object file in Intel hexadecimal format.

Both versions of the cross assembler include pseudo-ops, conditional assembly, and cross-reference tables. Both run on the IBM PC, XT, AT, and compatibles with 64K bytes of memory. The absolute version costs $250, and the relocatable version with linker is $400. Contact United States Software Corp., 5470 Northwest Innisbrook Place, Portland, OR 97229, (503) 645-5043.
Inquiry 586.

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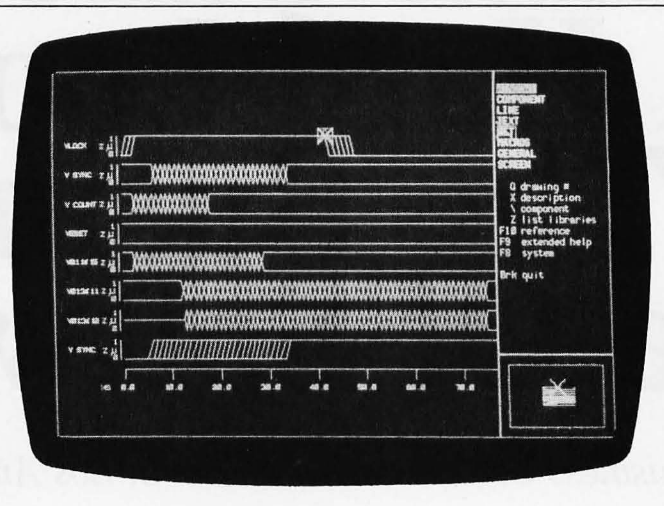
SOFTWARE • SCIENTIFIC AND ENGINEERING

Timing Verifier for Circuit Designs

Case Technology has introduced the Case Timing Verifier (CT2600) for the IBM PC AT. Based on the original Scald timing verifier developed at Lawrence Livermore Laboratories, the program performs worst-case timing verification. It checks for all timing errors that might occur through the full range of a circuit's delays and generates waveforms displayed on screen that indicate a logic design's worst-case timing parameters.

The program verifies partial and completed designs and detects setup and hold errors, race conditions, minimum pulse width errors, and clock glitches. It accepts values for wiring delays generated by Case's PCB layout program and can reveal timing problems in the physical PCB layout.

The Case CT2600 Timing Verifier for the PC AT costs $3500. For more information, contact Case Technology Inc., 633 Menlo Ave., Suite 250, Menlo Park, CA 94025, (415) 322-4057.
Inquiry 587.



The Case CT2600 Timing Verifier.

Tool for Scientific and Engineering Calculations

Calculus, from A I Ware, is a calculator program that features mathematical functions commonly used in scientific and engineering calculations.

Among the software's features are Bessel functions, polynomial-root calculations, matrix operations, and memory-management commands. The program supports real and complex numbers in most mathematical functions. It operates in a simple calculator mode as well as in an advanced mode that, the company says, uses a command structure similar to that in spreadsheets.

Calculus costs $99. It runs on the IBM PC, XT, AT, and compatibles. The program requires 192K bytes of memory and an 8087 or 80287 math coprocessor.

For more information, contact A I Ware Inc., POB 367, Rosemead, CA 91770, (818) 446-0998.
Inquiry 588.

Structural Analysis and Design

Innovative Analysis's Larsa is a structural analysis and design program for engineers and architects. The software analyzes two- and three-dimensional structures such as buildings, bridges, towers, and most other conventional structures. It performs static and dynamic linear and static nonlinear analysis and lets you study displacements, stresses, and forces.

The software includes modules for data entry, editing, analysis, plotting, and report generation. It lets you display and plot complete and partial models and generate nodes, elements, and loads.

Larsa runs on the IBM PC, XT, and AT. It requires a minimum of 512K bytes of RAM, a 10-megabyte hard-disk drive, and an 8087 or 80287 math coprocessor. Larsa Linear and Nonlinear Analysis sells for $3495. Larsa Linear Analysis costs $1995. Contact Innovative Analysis Inc., 330 West 42nd St., New York, NY 10036, (212) 736-1616.
Inquiry 589.

SOFTWARE • BUSINESS

Relational Database Program

XDB, from Software Systems Technology, is a relational database system designed for generating sophisticated applications. The system includes a query language, command language, database editor, report writer, menu generator, utilities, and an optional forms manager and graphics module. XDB's forms manager can access and update multiple tables. The program's import/export utility lets you transfer data to or from dBASE II and III, spreadsheet files, and other programs.

The software uses SQL, IBM's relational query language and the proposed ANSI standard for microcomputer and mainframe query languages. The company says that SQL minimizes the amount of programming required for generating applications.

XDB runs on IBM PCs and compatibles and requires between 192K and 320K bytes, depending on the modules you use. Three modules are available. The Extended Database System alone costs $450 and includes a query language, report writer, database editor, command language, menu generator, and utilities. The Form Manager option costs $225, and the Graph Writer option costs $75. A C-language interface is available for $500. Contact Software Systems Technology, 7100 Baltimore Ave., Suite 206, College Park, MD 20740, (301) 779-5486.
Inquiry 590.

3-D Designs on the Mac

MacSpace, a computer-aided design program for the Macintosh, lets you design three-dimensional objects. The program divides the screen into four win-

(continued)



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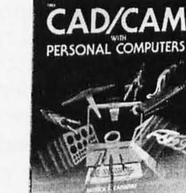


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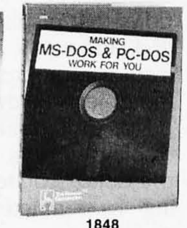




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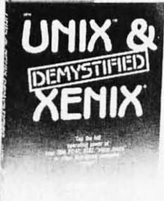


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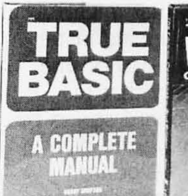


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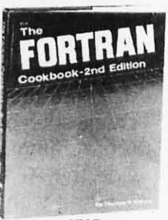
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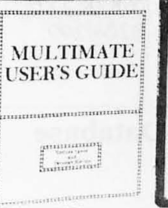
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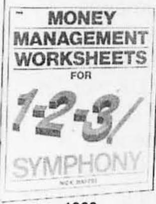
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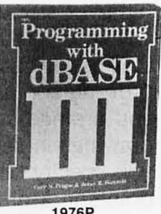
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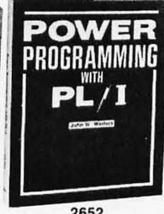
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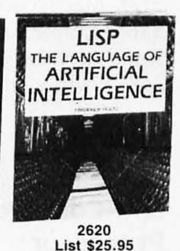
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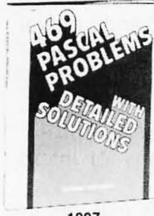
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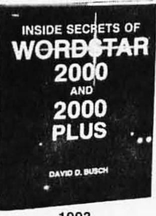
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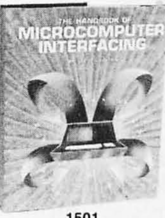
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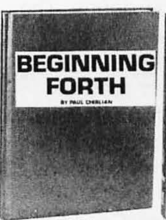
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dows that display top, front, and side views, as well as an axonometric projection of the object. Below the windows, an information strip displays various values of the object you're designing—its perimeter, surface, geometric quotes, or choice of drawings proposed.

MacSpace works with the Imagewriter and LaserWriter printers and can transfer drawings to MacPaint, MacDraw, and other graphics and drawing programs. It can also send output to a variety of Macintosh-compatible plotters.

The program runs on the 512K Macintosh and costs $385. Contact Abvent, 9903 Santa Monica Blvd., Suite 268, Beverly Hills, CA 90212, (213) 659-5157.
Inquiry 591.

Low-Cost Word Processor

WPro, a word-processing program for IBM PCs and compatible computers from Natural Language Inc., features a two-level interface designed for beginning and experienced computer users. You can customize and extend the interface with the macro definitions the program provides.

WPro has built-in forms management, windows, mail merge, label printing, concurrent print spooling, translation tables for foreign languages, automatic indentation, the ability to execute external programs or commands, and the ability to display directories. The program can combine text with images generated by business graphics and drawing programs. WPro can also import and export data to and from spreadsheets and database programs.

The program supports multiple fonts and runs on a variety of laser, dot-matrix, and daisy-wheel printers. WPro retails for $96 and runs on IBM PC and compatible computers with 256K bytes of RAM. For more information, contact Natural Language Inc., POB 13467, Kanata, Ontario K2K 1X6, Canada, (613) 820-8299.
Inquiry 592.

Graphics Database for CAD

Micro-Vector's CADRover is a graphics database program that finds and retrieves stored images you've created with other CAD packages. Designed for presentation, CADRover lets you arrange and display drawings in sequences. If you specify one or more points in a drawing, the program activates these points to display selected images in an order you define. The program can also link graphics with text.

CADRover can read a variety of file formats used by other applications programs and currently reads files produced by CAD-Master and VersaCAD. Selling for $495, the program runs on the IBM PC and compatibles. Contact Micro-Vector Inc., 1 Byram Brook Place, Armonk, NY 10504, (914) 273-8700.
Inquiry 593.

Software for Speeding PC ATs

Dynamical Systems' software utility, AT SpeedFixer, facilitates speeding up an IBM PC AT. The package consists primarily of a memory-resident program designed to prevent disk-drive errors that might occur with an AT running faster than 6 MHz. Also on the disk is a utility that increases keyboard speed by reprogramming the chip inside the AT keyboard.

Along with the software come instructions on how to speed up an AT by replacing the crystal and how to quicken a hard disk used with an accelerated AT.

AT SpeedFixer costs $24.95. For more information, contact Dynamical Systems Inc., 2511 Fulton St., Berkeley, CA 94704, (800) 227-2400, ext. 929.
Inquiry 594.

Atari ST Graphics Software

DEGAS, from Batteries Included, runs on the Atari 520ST and 1040ST. The program incorporates GEM and adjusts to whichever ST graphics mode you use.

Within DEGAS, you can employ drawing functions; choose your colors; design your own brush, fill, and line patterns; and use magnify, shadow, mirror, and airbrush features. The mouse acts as paintbrush or pencil, and a click can move you between the main menu and the drawing screen. The program allows combined text and graphics and lets you create your own text fonts.

The results of work with DEGAS can be printed on any Epson or compatible graphics printer. DEGAS costs $39.95 U.S. ($54.95 Canadian). Contact Batteries Included, 30 Mural St., Richmond Hill, Ontario L4B 1B5, Canada, (416) 881-9816. U.S. sales: 17875 Sky Park North, Suite P, Irvine, CA 92714, (714) 250-8723.
Inquiry 595.

CP/M for MS-DOS Computers

RUN/CPM, from Micro Interfaces, is packaged with NEC's V20/V30 microprocessor and is designed for running CP/M software on the IBM PC and compatible computers. In addition to being compatible with Intel's 8088 and 8086, the NEC microprocessor provides instructions for Intel's 8-bit 8080.

The software's features include 15 logical and physical drive assignments, support for subdirectories and pathname assignments, terminal emulation for many CP/M terminals, a disk-transfer utility for transferring CP/M software to MS-DOS format, and the ability to issue MS-DOS commands in CP/M mode.

RUN/CPM sells for $99.95 and includes software, the NEC V20/V30 microprocessor, and documentation. Contact Micro Interfaces Corp., 6824 Northwest 169th St., Miami, FL 33015, (305) 823-8088.
Inquiry 596.

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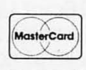
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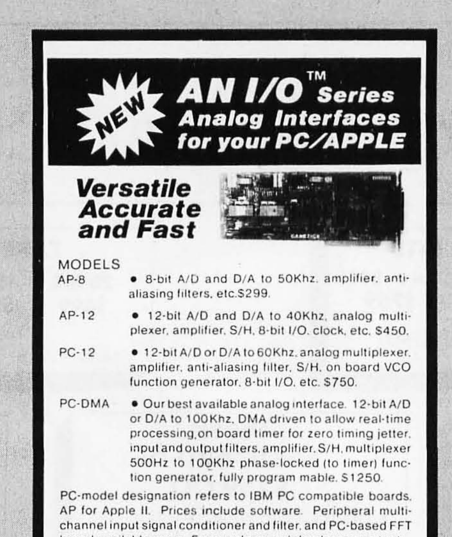
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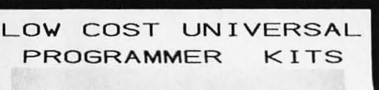
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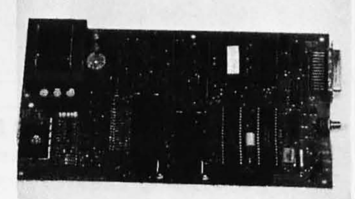
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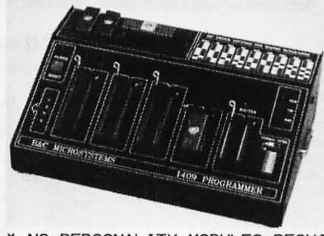
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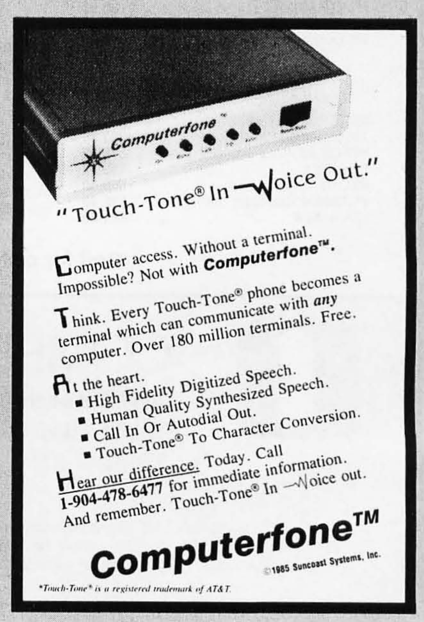


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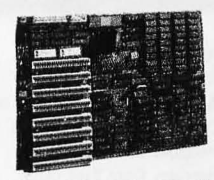
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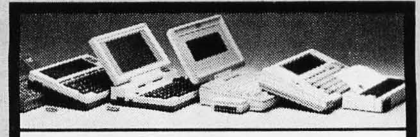
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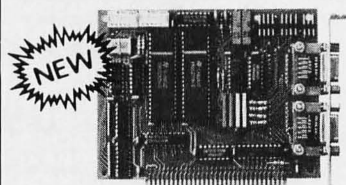
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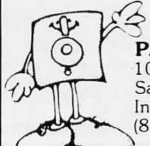
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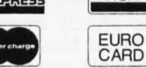
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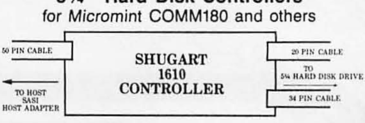
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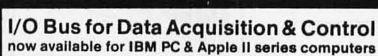


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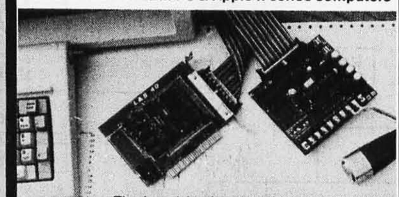
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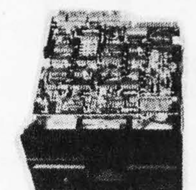
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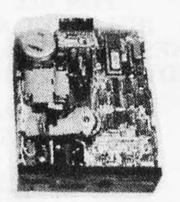
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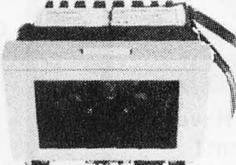


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12 VDC



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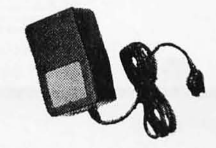


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75-KEY MECHANICAL KEYBOARD — For Adam



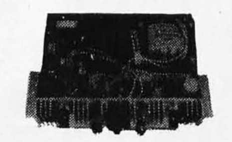
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♥ of the 'ADAM'



Logic board for the Adam computer. Includes the following components: 8 ea. 4164-4s, 74LS157, 74LS541, LS273N; 2 ea. LM339s, plus microprocessors with ROMs.
Mfr — Coleco
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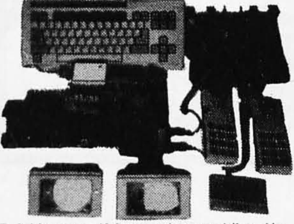
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DC Output: −5V @ 200 ma.
+5V @ 3 amps
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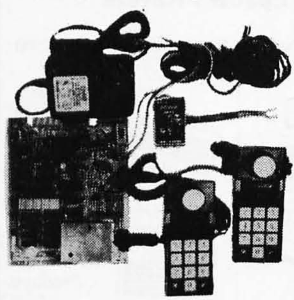
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5269	7.5	9	36	1) 1³⁄₁₄ L x 2¾ dia 2) ¼ dia. x ½ L	N.A. Phillips B82916	2/ 17.95
5275	1.8	1.8	72	1) 2³⁄₁₆ L x 2³⁄₁₆ dia 2) ¼ dia. x ¾ L	Superior Elec. MO61-FF-6201B	2/ 37.50

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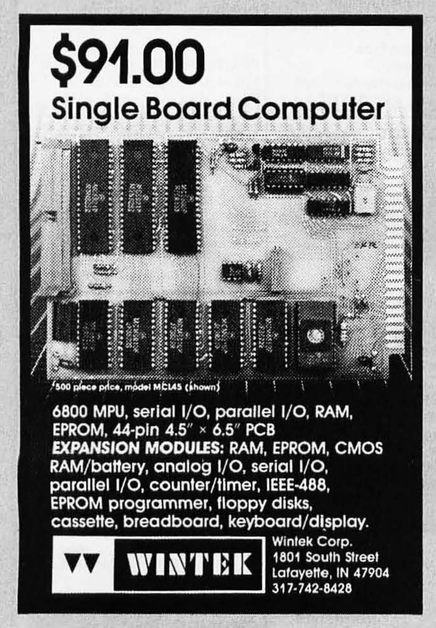
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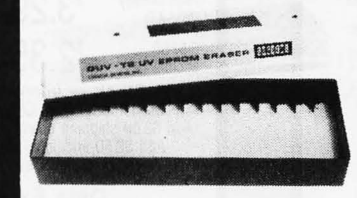
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Inquiry 269

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Inquiry 225





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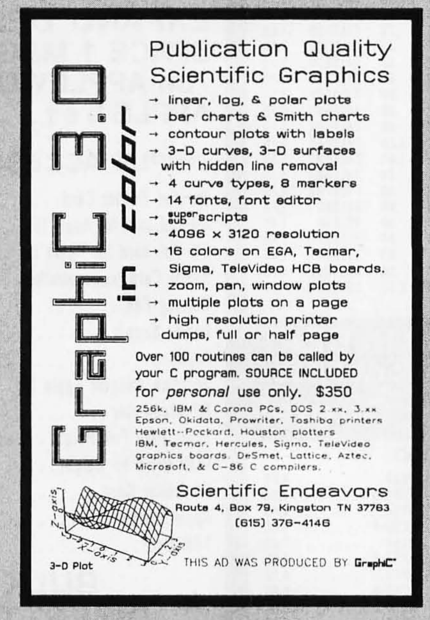
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Inquiry 326



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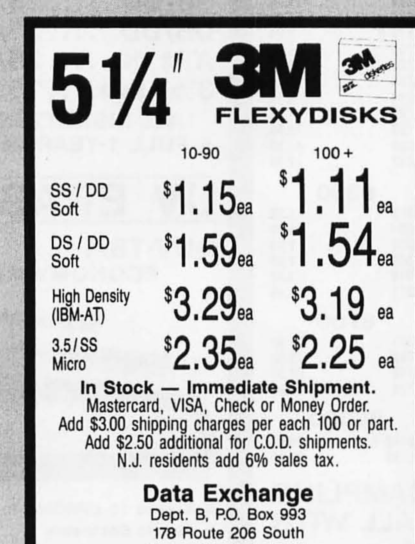
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Inquiry 194



Inquiry 108

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64K	64Kx1	150 ns	1.15
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27256	32Kx8	250 ns	4.75
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- many many more little features

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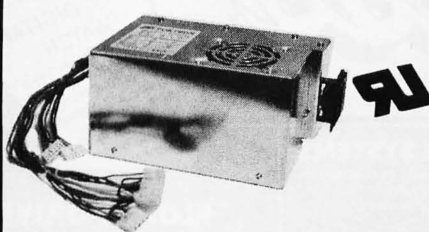
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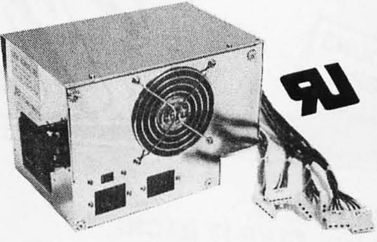
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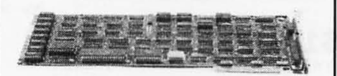
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Color Graphic/Mono/Printer



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- 320 × 200 (color) 640 × 200 (B&W)
- Centronics printer port

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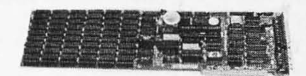
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- 720 × 348 graphic mode
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- Memory expansion to 384K
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- Serial, parallel ports
- Game port

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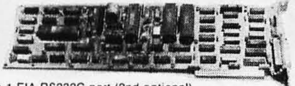
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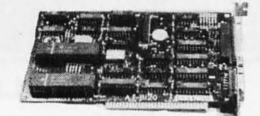
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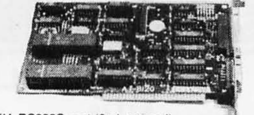


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- Battery back-up

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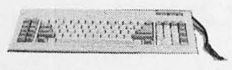
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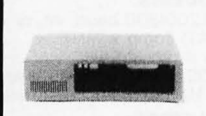
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- For PC XT
- Large return key
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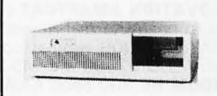
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- To use FC 135-40 power supply
- Complete mounting hardware

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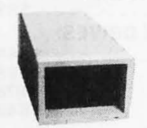
FC 630 A-T



- For PC AT compatible
- LED lamps, key, key lock, speaker and mounting hardware, included.

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FC 610
Drives Chassis

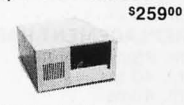


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- Come w/power supply, fan
- LED power indicator

$149.00

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Expansion Chassis

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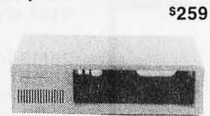


- W/5 slot mother board
- 100W power supply, fan
- Capable of holding 3 half-height drives
- Dia. 15½" × 12" × 6¼"
- Option of system interface adaptor

$159.00

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- PC XT identical size
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- System interface adaptor

$159

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Expansion Chassis

$299

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10 MB	419.00
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20 MB ST-4026 (40ms)	Call
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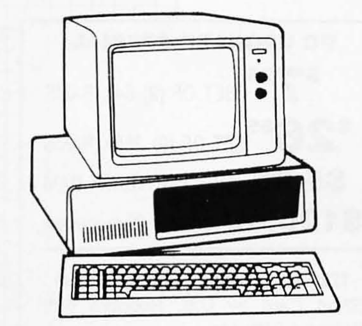
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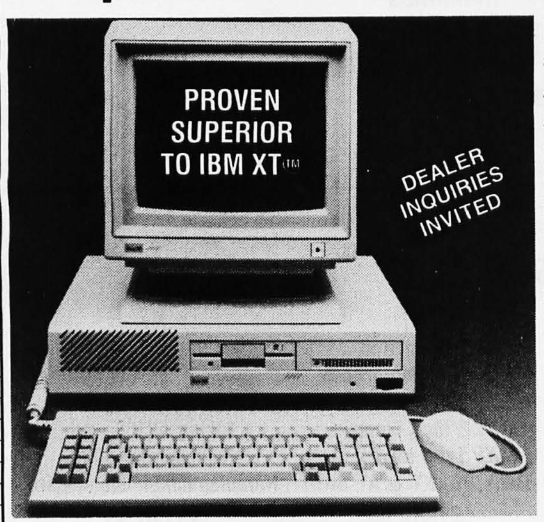
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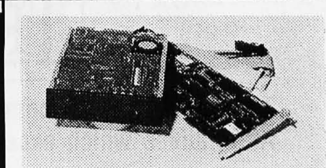
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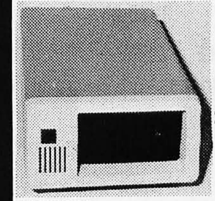


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14 Pin ST/LP	.15	.11
16 Pin ST/LP	.17	.12
18 Pin ST/LP	.20	.17
20 Pin ST/LP	.28	.26
22 Pin ST/LP	.29	.27
24 Pin ST/LP	.29	.27
28 Pin ST/LP	.39	.32
36 Pin ST/LP	.45	.36
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18 Pin WW/3L	.88	.77
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24 Pin WW/3L	1.25	1.17
28 Pin WW/3L	1.49	1.39
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2N2218A	.45	TIP30A	2/1.00
2N2219A	.45	TIP31A	2/1.25
2N2905	.45	TIP32A	2/1.25
2N2907	.25	1N4148	25/1.00
2N3055	.69	1N751	5/1.00
2N3565	4/1.00	1N4002	12/1.00
2N3638	4/1.00	1N4004	10/1.00
2N3772	1.69	MPQ2232	1.49

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MCA-255	1.69	4N38	.98
4N26	.65	TIL117	.79
4N27	.65	SPX33	.29
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DB25P (Male)	2.40	2.29
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Rt Angle Solder Header	IDHxxSR	.79	1.20	1.65	2.10	2.40	3.00
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Ribbon Header	IDMxx	—	5.25	5.95	6.75	7.25	8.25
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6803	18.95	6840	12.75	6880	2.20
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8039	5.75	8216	1.95	8271	69.95
8080A	2.95	8224	2.20	8275	26.95
8085A	4.90	8226	1.95	8279	8.75
80C85A	9.95	8228	3.40	8282	6.25
8086	24.50	8237	13.75	8283	6.25
8087-2	129.95	8237-5	15.95	8284	5.50
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8089	88.95	8243	3.95	8287	6.45
8155	6.75	8250	10.50	8288	11.95
8156	6.75	8251	4.25	8289	44.95
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8202	23.95	8253	6.75	8741	27.95
8203	37.95	8255	4.25	8748	24.50
8205	3.25	8255A	5.95	8749	24.50
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	2.5MHz	"A" 4.0MHz	"B" 6.0MHz
Z80-CPU	2.25	2.75	6.95
Z80-CTC	2.50	3.75	9.25
Z80-DART	7.50	8.50	17.95
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1791	22.75	2793	32.95	1691	6.95
1793	21.50	2795	32.95	2143	6.95
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2732 (450nS)	1.95	MCM68766 (350nS)	21.95
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2732 (200nS)	4.95	27128 (250nS)	15.95
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21L02 (450nS)	.99	TMM2016-2 (200nS)	3.10
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2111 (450nS)	2.75	HM6116P-4 (200nS)	4.75
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4002	.22	4030	.39	4066	.39	4507	1.10
4006	.79	4031	3.25	4069	.28	4508	1.90
4007	.22	4032	2.15	4070	.35	4510	.79
4008	.95	4034	1.91	4071	.28	4511	.79
4009	.39	4035	.79	4072	.28	4512	.79
4010	.39	4037	1.95	4073	.28	4514	1.18
4011	.24	4040	.75	4075	.28	4515	1.79
4012	.24	4041	.75	4076	.75	4516	1.19
4013	.35	4042	.65	4077	.35	4518	.85
4014	.75	4043	.85	4078	.35	4520	.75
4015	.39	4044	.69	4081	.29	4555	.95
4016	.35	4046	.80	4082	.29	4556	.95
4017	.65	4047	.89	4085	.95	4566	1.35
4018	.79	4048	.99	4086	.95	80C95	1.50
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4020	.69	4050	.34	4094	2.95	MC14408	12.95
4021	.69	4051	.75	4098	1.90	MC14409	12.95
4022	.69	4052	.75	4099	1.85	MC14410	9.95
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4027	.45	CALL FOR 74HC					

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LM308CN	.65	LM723N	.55	RC4136	1.19
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LM311CN	.62	LM733	.98	CA3023	2.75
LM312H	1.75	LM739	1.85	CA3039	1.25
LM318CN	1.45	LM741CN	.33	CA3046	1.25
LM318H	1.55	LM741H	.40	CA3059	2.85
LM319N	1.19	LM741N	.55	CA3060	2.85
LM320 (see VRs)		LM747	.65	CA3065	1.69
LM324N	.55	LM748	.55	CA3080	1.10
LM339N	.55	LM1014	1.15	CA3081	1.60
LM340 (see VRs)		LM1303	1.90	CA3082	1.60
LM348N	.95	LM1310	1.45	CA3083	1.55
LM358CN	.65	MC1330	1.65	CA3086	.80
LM359	1.75	MC1349	1.85	CA3089	2.95
LM360N	2.95	MC1350	1.15	CA3096	3.45
LM370N	4.95	MC1358	1.65	CA3130	1.29
LM373N	3.95	MC1372	6.75	CA3140	1.15
LM376N	3.75	LM1414	1.55	CA3146	1.79
LM377N	1.90	LM1558H	2.99	CA3160	1.49
LM380CN	.85	LM1800	2.35	LM13080	1.25
LM380N	1.05	LM1812	8.10	LM13600	1.45
LM381N	1.59	LM1830	3.40	LM13700	1.45
LM382N	1.35	LM1871	5.45	LF347	2.19
LM383N	1.95	LM1872	5.45	LF351	.60
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LM387N	1.29	LM1896	1.70	LF356	1.10
LM389N	1.15	ULN2001	1.55	LF357	1.39
LM392N	.69	ULN2003	1.49	TL071CP	.79
LM723N	.48	XR2206	3.75	TL072CP	1.45
LM723H	.55	XR2207	2.90	TL074CN	1.90
NE531	2.85	XR2208	2.40	TL081CP	.59
NE555	.35	XR2211	3.75	TL084CN	1.90
NE556	.65	LM2877P	2.05	TL494	4.10
NE558	1.49	LM2878P	2.25	TL496	1.65
NE561	23.50	LM2900	.83	TL497	3.20
NE564	2.85	LM2901	.99	MC3423	1.49
LM565	.95	LM2903	.69	MC3453	4.95
LM566	1.45	LM2907	2.45	MC3456	1.29
LM567	.85	LM2917	2.85	MC3459	3.75
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7400	$ .18	7446	$ .68	74123	$ .45	74176	$ .69
7401	.18	7447	.65	74125	.42	74177	.69
7402	.18	7448	.68	74126	.44	74179	1.34
7403	.18	7450	.19	74128	.49	74180	.75
7404	.18	7451	.19	74132	.45	74181	1.75
7405	.23	7453	.19	74136	.75	74182	1.15
7406	.49	7454	.19	74141	.85	74184	2.25
7407	.49	7459	.25	74142	2.95	74185	2.25
7408	.24	7460	.37	74143	3.70	74190	.67
7409	.19	7470	.29	74144	2.95	74191	.67
7410	.19	7472	.29	74145	.59	74192	.67
7411	.24	7473	.33	74147	1.49	74193	.67
7412	.38	7474	.34	74148	1.19	74194	.67
7413	.34	7475	.38	74150	1.09	74195	.67
7414	.49	7476	.34	74151	.55	74196	.75
7416	.49	7479	4.60	74152	.67	74197	.86
7417	.49	7480	.69	74153	.53	74198	1.15
7420	.19	7482	.95	74154	1.19	74199	1.15
7421	.35	7483	.45	74155	.69	74221	1.19
7422	.45	7485	.55	74156	.69	74251	.75
7423	.58	7486	.35	74157	.59	74273	1.65
7425	.29	7489	1.95	74158	1.65	74276	1.89
7426	.29	7490	.35	74159	1.58	74279	.75
7427	.25	7491	.65	74160	.79	74283	1.40
7428	.55	7492	.45	74161	.69	74284	2.90
7430	.18	7493	.35	74162	.69	74285	2.90
7432	.29	7494	.85	74163	.69	74290	1.49
7437	.25	7495	.50	74164	.69	74298	1.49
7438	.29	7496	.69	74165	.69	74365	.55
7439	.58	7497	2.70	74166	.85	74366	.55
7440	.19	74100	1.50	74167	2.75	74367	.55
7441	.79	74107	.24	74170	1.25	74368	.55
7442	.45	74109	.37	74172	4.75	74390	1.45
7443	1.15	74116	1.45	74173	.69	74393	1.33
7444	1.15	74121	.29	74174	.69	74490	2.25
7445	.68	74122	.44	74175	.69		

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74LS03	.15	74LS123	.95	74LS251	.59
74LS04	.24	74LS124	2.75	74LS253	.59
74LS05	.25	74LS125	.49	74LS257	.59
74LS08	.27	74LS126	.49	74LS258	.59
74LS09	.28	74LS132	.59	74LS259	2.95
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74LS13	.39	74LS145	1.19	74LS273	1.45
74LS14	.59	74LS148	1.38	74LS275	3.29
74LS15	.33	74LS151	.55	74LS279	.59
74LS20	.26	74LS153	.55	74LS283	.68
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74LS22	.29	74LS155	.69	74LS293	.78
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74LS28	.29	74LS158	.69	74LS324	1.75
74LS30	.25	74LS160	.69	74LS347	1.95
74LS32	.33	74LS161	.69	74LS348	1.95
74LS33	.53	74LS162	.69	74LS352	1.25
74LS37	.35	74LS163	.69	74LS353	1.25
74LS38	.39	74LS164	.69	74LS363	1.29
74LS40	.25	74LS165	.90	74LS365	.48
74LS42	.44	74LS166	1.90	74LS366	.48
74LS47	.74	74LS168	1.15	74LS367	.45
74LS48	.74	74LS169	1.15	74LS368	.45
74LS51	.25	74LS170	1.40	74LS373	1.39
74LS54	.29	74LS173	.67	74LS374	1.33
74LS55	.29	74LS174	.67	74LS375	.69
74LS73	.39	74LS175	.67	74LS377	1.38
74LS74	.34	74LS181	1.95	74LS385	1.95
74LS75	.39	74LS190	.85	74LS386	.45
74LS76	.39	74LS191	.85	74LS390	1.15
74LS78	.39	74LS192	.78	74LS393	1.15
74LS83	.59	74LS193	.78	74LS395	1.15
74LS85	.69	74LS194	.69	74LS399	1.47
74LS86	.39	74LS195	.69	74LS424	2.95
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74LS92	.54	74LS197	.79	74LS670	2.29
74LS93	.54	74LS221	.89	81LS95	1.45
74LS95	.75	74LS240	.95	81LS96	1.45
74LS96	.89	74LS242	.95	81LS97	1.45
74LS107	.39	74LS243	.95	81LS98	1.45
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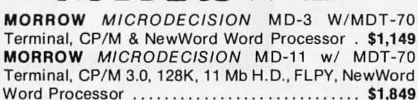
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TECMAR *LABMASTER* .... **CALL**
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ACKERMAN *KLUGE CARD A&T* **$175**
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CCS *2710* 4 Port Serial Board **$275**
CCS *2720* 4 Port Parallel Board **$215**
CCS *2810* Z80 CPU with Serial Port **$235**
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COMPUPRO *RAM 22* 256K STATIC **$479**
COMPUPRO *RAM 23* 128K STATIC **$285**
COMPUPRO *MDRIVE/H-10-1Mb* for 816/10 ..... **$589**
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PROMETHEUS *300C* Apple IIC Piggy Back **$139**
PROMETHEUS *1200B* For PC'S with Procom ... **$239**
PROMETHEUS *1200M* Stand Alone MAC Modem with Cable and Communications Software **$348**
HAYES *SMART MODEM 1200* RS-232 .... **$429**
HAYES *SMART MODEM 2400* Universal **$659**
U.S. ROBOTICS *PASSWORD 1200* **$225**
U.S. ROBOTICS *AUTO DIAL 212A* **$309**
U.S. ROBOTICS *PC/XT MODEM* with TELPAC.. **$199**
U.S. ROBOTICS *PC MULTI-MODEM* with Clk-Cal., Batt. Back-up, PRT Port, 256K RAM Telpac **$395**
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We have Access to all Well Known Brands - **ORDER CORRECTLY -- SOFTWARE IS NOT RETURNABLE!**

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MICROPRO *CORRECT STAR* / PC-DOS......... **$95**
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MARK OF THE UNICORN *THE FINAL WORD*... **$189**
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COMPUVIEW *V-SPELL* CP/M 80 8" & PC DOS.. **$59**

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BORLAND *PC TURBO PASCAL* 3.0 W/ 8087 ..... **$70**
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BORLAND *PC SUPERKEY* (Unprotected) **$41**
BORLAND *PC TURBO GRAPHIX TOOLBOX*..... **$35**
BORLAND *PC TURBO TOOLBOX*............... **$35**
BORLAND *PC TURBO TUTOR*.................. **$22**
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Hobby Corner

SOLD "AS IS" WITH NO RETURNS ....
ELECTROLOGICS *QUASI-DISK* CP/M80 RAM DISK with Battery Back-up: *2Mb*....**$1,695**/*4Mb* **$3,095**
ITHACA *PASCAL Z* CP/M80 8" Version 4.0 ..... **$195**
MORROW *MD-2* w/MP100 Daisy Printer, CP/M 2.2, Word Proc., Spreadsheet, Basic, Etc., Software .. **$695**
NORTH STAR *ADVANTAGE* G/MSDOS & CP/M **$169**
NOVATION *SMART CAT 212* **$219**
PMMI *MM-103* 600 Baud S-100 Modem **$139**
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SD SYSTEMS *VERSAFLOPPY III* with CP/M 3.0 . **$195**
SD SYSTEMS *RAMDISK* 256K.................. **$195**
SD SYSTEMS *MPU-100* Z80 CPU Kit **$89**
SEATTLE *SYSTEM SUPPORT BOARD* **$169**
SMS *STATIC RAM* 64K For N.S. Horiz. Etc. **$149**
TEI *TFD-O* Cabinet For 3 STD 5¼" FLY. DRVS. . **$195**
TRANSEND/SSM *MB8A Kit* 16K EPROM BD. **$59**
TRANSEND/SSM *EP128* Reads Up To 16 EPROMS **$89**

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California Digital

17700 Figueroa Street • Carson, California 90248

IBM Compatible Computer $495



- 256K Expandable to 640K on Motherboard
- Double Sided Double Density Disk Drive
- IBM Type Keyboard (with LED indicators)
- Floppy Controller Card
- Eight Expansion Slots
- 135 Watt Power Supply

The Eclipse 16 is an outstanding value in IBM Compatible Computers. After careful research and evaluation we found it to be the most reliable unit.

Our computer includes some of the newest features available, such as the 4.7MHz, multi-layer motherboard with 256K of RAM upgradable on board to 640K. A generous eight expansion slots and 135 Watt power supply give you ample room and power for add-on boards. The enclosure has an easy-access flip top lid making upgrades a breeze. And our floppy controller supports up to four drives, so as many as three additional drives can be used. Finally, each computer is configured and fully tested before sending it to you.

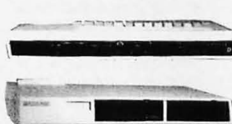
Satisfaction Guaranteed! We're really excited about this new unit, and so sure you will be too... that you may return the Eclipse 16 for a full credit towards an IBM PC if you are not completely satisfied.

OPTIONS

20MB Hard Drive w/Controller $495
Additional Drive-Installed........................99
Irwin 10 Meg. Tape Back up...................489
Upgrade from 256K to 640K RAM 79
8087 Math Co Processor........................119
Color Graphics Card 79
Monochrome Graphics Card...................99
RGB Color Monitor................................199
TTL Monochrome Monitor.....................139
Microsoft Mouse 139
Upgrade from Floppy Controller to Disk I/O 2 drive controller, clock/cal., software parallel, serial, and game ports...............79
1200 Baud Internal Modem w/Software 179

XEROX $299
SUNRISE COMPUTER





The Xerox Sunrise 1810 is by far the best value we have ever seen in a micro computer. This is a self contained battery and AC operated portable. The Sunrise was originally prices at $2995. Xerox has since elected to drop the computer from their product list. California Digital has purchased all the remaining inventory and is making the unit available at a fraction of its original cost.

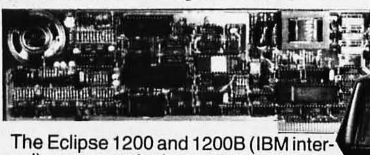
This portable features a built in 80 column liquid crystal display, 64K of memory along with both RF monitor and television outputs. The internal 300/1200 baud modem includes an auto dial telephone assembly. The units has both centronics parallel and a serial port programmable to 19,200 baud. The self contained micro cassette is capable of capturing data from the keyboard as well as doubling as an recorder for dictating messages.

An optional dual floppy disk drive module, pictured above, is available for only $219. Also available, for $59 is an 80 column printer that mounts in the drive module. The Sunrise features a CP/M operating system which allows the operator to use any CP/M program in Xerox 5¼" disk format and over 5000 CP/M programs available in public domain.

We have avalable a 15 minute tape on the Sunrise Computer. The tape is in VHS format and was produced by Xerox to promote the computer. California Digital is offering the promotional tape at $15. This will be applied towards purchase price of the Sunrise 1810 computer.

Eclipse 1200
1200 Baud Hayes Compatible

Your Choice $179



The Eclipse 1200 and 1200B (IBM internal) represent the best value we have ever offered in a fully Hayes Compatible 300/1200 baud modem. Both units include speaker, auto dial and data communication software. The external also features status indicators LED's. The internal includes an auxillary RS-232 serial port. California Digital is so comfident of your complete satisfaction that we will allow the return of either Eclipse 1200 modem and apply the full credit towards the purchase price of any other modem.

1200 BAUD MODEMS

PROMETHEUS ProModem 1200 $289

This Hayes compatible modem features completely unattended operation, auto answer/auto dial and even includes "redial number when busy". Help commands, real time clock and internal speaker add to the ease of use of this unit.

SMARTEAM 1200 $189

The Team 212A offers all the features of the Hayes Smart Modem 1200 for a fraction of the price. Now is your opportunity to purchase a 1200 baud modem at the price of a 300 baud modem.

SIGNALMAN 300 BAUD MARK VI $49



The Anchor Automation Mark VI is a 300 baud direct connect modem that plugs into any slot of your IBM/PC. This modem supports auto answer and auto dial capabilities. Other features include telephone number storage, send / receive text files, single key-stroke dialing along with many other functions provided on disk. The Mark VI was originally priced at over $300.

UltraLink 1200 $99



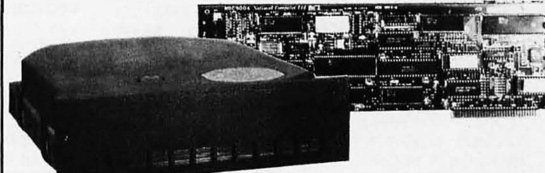
The UltraLink is a 1200 baud HALF DUPLEX bell 202 compatible internal modem card for the IBM/PC. This unit operates full duplex at 300 baud.
The UltraLink adds a voice/data demension to your PC. Manufacturers original suggested price on this modem is $795. California Digitals price is only $99.

MODEMS

Eclipse 1200 100% Hayes, with status lamps.	ECP-1200	179.00
Eclipse 1200B internal with software	ECP-1200B	179.00
Hayes Smartmodem 2400 baud modem	HYS-2400	599.00
Fujitsu 2400/1200 baud auto everything.	FUJ-1935D	459.00
Team 1200 Hayes Compatible, 300/1200 baud.	TEM-SM1200	189.00
UltraLink 1200 data and voice on same line.	UTL-1200A	99.00
CTS 212AH 1200 baud, auto dial	CTS-212AH	219.00
Terminal software for CTS 212AH	CTS-212SFT	35.00
Prometheus 1200 super features	PRM-P1200	289.00
Prometheus 1200B internal PC	PRM-P1200B	279.00
Signalman Mark VI, 300 baud internal PC	SGL-MK6	49.00
Hayes Smart Modem 1200 baud, auto dial	HYS-212AD	369.00
Hayes 1200B for use with the IBM/PC, 1200 baud.	HYS-1200B	299.00
Hayes Smartmodem, 300 baud only, auto dial	HYS-103AD	199.00
Hayes Chronograph, time & date	HYS-CHR232	199.00

Seagate $359
20 MEGABYTE WINCHESTER HARD DISK DRIVE

Quantity Two



Five Inch Winchester Disk Drives

	each	two+
SEAGATE 225 20 Meg. ½ Ht.	389	359
SEAGATE 4026 26 M. 35mS.	859	829
SEAGATE 4051 51 M. 35mS.	1095	1059
FUJITSU 2242 55 M. 35mS.	1799	1729
FUJITSU 2243 86 M. 35mS.	2295	2219
RODIME RO-202E 27 Meg.	759	729
RODIME RO-203E 40 Meg.	995	959
RODIME RO-204E 53 Meg.	1259	1195
CONTROL DATA 94155-86 M.	1829	1779
MAXTOR XT1140 140 Meg.	3379	3295
HONEYWELL 85M. 27 mS.	1795	1695
TOSHIBA MK56 70 M. 30mS.	1789	1729
TANDON 502 10 Meg.	419	379

• Winchester Controllers for IBM/PC •

FALCON FT-HDC half card	18
XEBEC 1220 with floppy controller	26
NATIONAL COMPUTER 5004	15
DTC 5150BX	15
OMTI 5510 half card	18
ADAPTEC 2010A software install	18
WESTERN DIGITAL WD/1002	18

• SCSI/SASI Winchester Controllers •

XEBEC 1410A 5¼" foot print	23
OMTI 20L	11

• Winchester Accessories •

Installation Kit with manual	
Winchester enclosure and supply	1
Dual 20/34 cable set	
Switching power supply	

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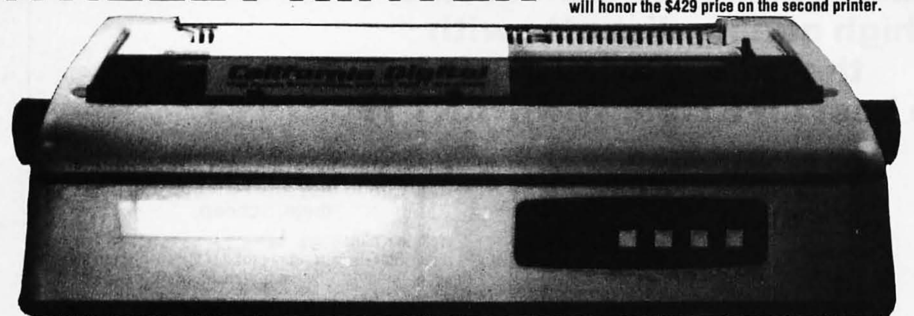
California Digital

17700 Figueroa Street ● Carson, California 90248

LETTER QUALITY F-10 DAISY WHEEL PRINTER

$429 Quantity Two

Single piece price $499. But if you have already purchased an F-10 printer from California Digital, we will honor the $429 price on the second printer.



The TEC F-10 Daisy Wheel printer is the perfect answer to a reasonablly priced 40 character word processing printer. While this printer is " extremely" similar to C.Itoh's F-10/40 Starwriter printer. Legal counsel for the C.Itoh Company have advised us that we should refrain from referring to the TEC printer as a Starwriter.

This 40 character per second printer auto installs with Wordstar and Perfect Writer. Features extensive built-in word processing functions that allow easy adaptability and reduced software complexity. Industry standard Centronics interface provides instant compatibility with all computers equiped with a parallel printer port. The TEC F-10 accepts paper up to 15 inches in width.

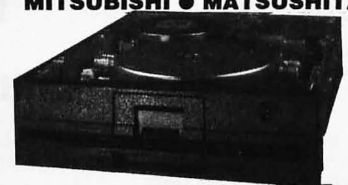
These printers were originally priced to sell at over $1400. Through a special arrangment California Digital has purchase these units from a major computer manufacturer and is offering these printers at a fraction of their original cost.

Options available include sheetfeeder, tractor feed, buffered memory and an assortment of printer cables for a variety of computers.

5¼" DISK DRIVE SALE $89

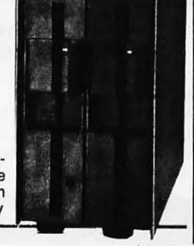
Quantity Two

Your Choice any 48 or 96 TPI drive
SHUGART ● TEAC ● QUME
MITSUBISHI ● MATSUSHITA



	One	Two	Ten
TEAC FD55B half height	99	89	89
TEAC FD55F 96 TPI, half ht.	119	89	89
TEAC FD55FG for IBM AT	189	179	175
SHUGART SA455 Half Height	99	89	89
SHUGART SA465 ½ Ht. 96TPI	99	89	89
TANDON 100-2 full height	129	125	119
MITSUBISHI 4851 half height	99	89	89
MITSUBISHI 4853 96/TPI½ Ht.	99	89	89
MITSUBISHI 4854 8" elec.	295	285	275
QUME 142 half height	99	89	89
Switching power supply			49
Installation Kit with manual			10
Dual enclosure for 5¼" drives			59
34 pin edge connectors			5
Scotch head cleaning kit			19
Flip & File Storage tubs			15

MITSUBISHI SUBSYSTEM $239



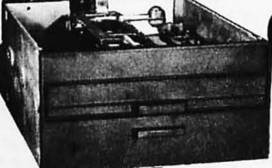
The dual Mitsubishi subsystem features two M48535 (96 tpi) 5¼" double sided disk drives. Also supplied within the subsystem is 50 watt power supply

IRWIN Streamer Tape Back Up $489

The Irwin Streamer Tape Drive is a low cost answer to backing up your hard disk drive. One removable cartridge can backup 10 megabytes of data in less than eight minutes.

The Irwin drive includes software for file by file or total disk backup. All programs are menu driven for easy use.

QUME $149



Eight Inch Single Sided Drives

QUME 841 single side	159	149	call
SHUGART 801R	359	359	354
SIEMENS FDD 100-8	119	115	109

Eight Inch Double Sided Drives

QUME 842 "QUME TRACK 8"	189	179	call
SHUGART SA851R	495	485	475
OLIVETTI double sided	189	179	159
REMEX RFD-4000	179	169	159
MITSUBISHI M2896-63 ½ Ht.	459	449	409
Dual 8" enclosure with power and fan			259
Switching power supply			89
Installation kit with manual			10

PLOTTER $219



The Comrex Comscriber I is the ideal solution to make short work of translating financial and numeric data into a graphic presentation.Many ready to run programs such as Lotus 1-2-3, Visi-on and Apple business graphics already support this plotter.

The Comscriber I features programmable paper sizes up to 8½ by 120 inches, 6 inch per second plot speed and 0.004" step size.Easy to implement Centronics interface allows the Comscriber I immediate use with the printer port of most personal computers.

The Comscriber I is manufactured for Comrex by the Enter Computer Corporation. The plotter is marketed by Heath Kit and also sold under Enters own "Sweet P" Label. This is your opportunity to purchase a plotter which was originally priced at $795 for only $219.

Also available is a support package which includes demonstration software, interface cable, a multicolor pen assortment and a variety of paper and transparency material.

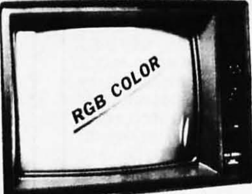
Quick-Link 300 $59



The Quick-Link 300 gives you an instant link to any dial up data base. Such as Dow Jones, Western Union or the Source. The Quick-Link has four user programmable log-on keys, allowing the operator, with only one key stroke, to dial the data base, log-in and give the password. All this information is permanently stored in non-volatile RAM.

Features include video output to television or monitor, auto dial, auto-log, full sized keyboard, 300 baud modem and 1200 baud auxillary printer port. All this is available for only $59.

NEC RGB COLOR MONITOR $219

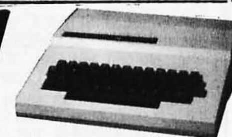


The NEC JC-1401D is a 13" medium/high resolution RGB monitor suitable for use with the Sanyo MBC-550/555 or the IBM/PC. The monitor features a resolution of 400 dots by 240 lines. Colors available are Red, Green, Blue, Yellow, Cyan, Magenta, Black and White.

The NEC monitor carries the Litton-Monroe label and was originally scheduled for use in their "Office of the Future" equipment. A change in Monroe's marketing strategy has made these units excess inventory which were sold to California Digital. We are offering these "new" RGB monitors at a fraction of their original cost. Sanyo compatible NEC-1401/S; IBM/P/C Computer compatible NEC-1401/PC

DRAGON $99





Compatible with most Radio Shack Color Computer software. The world famous Dragon computer is now available in the United States. Manufactured by the Tano Corp. under license of the British Broadcasting Company.

The Dragon comes complete with 64K Byte of memory, serial modem port along with a Centronics printer interface. This unique microcomputer features Motorola's advanced 6809E microprocessor and comes standard with Microsoft Color Basic, data base manager, and a complete word processing package. The computer outputs color composite video along with R.F. video that allows the unit to be used in conjunction with any color television.

This is the Ideal low cost computer to be used with any dial up information system such as the Source, EasyLink or any other time share service.

PRINTERS

MATRIX PRINTERS

Star Gemini-SG10 120 char/sec.	STR-SG10	239.00
Star Gemini-SG15, 100 char./sec. 15" paper.	STR-SG15	389.00
Star Gemini Delta 10, 160 Char/sec	STR-D10	359.00
Citizen MSP/10FT 160 char/sec.	CIT-MSP10	289.00
Toshiba P1351, 192 char/sec. letter quality	TOS-1351	1495.00
Okidata 182A serial & parallel 9½" paper	OKI-182A	257.00
Okidata 192A parallel interface, 160 char/sec.	OKI-192A	345.00
Okidata 84P parallel 15" paper	OKI-84P	789.00
Epson LX-80 10" 120 Char/sec.	EPS-LX80	239.00
Epson FX80FT, 10" 160 char./sec. with graphtrax	EPS-FX80	369.00
Epson RX100+ 15" withGraphtrax	EPS-RX100	389.00
Epson FX100FT 15" 160 char./sec with graphtrax	EPS-FX100	489.00
Epson LQ1500, 15" corespondence quality	EPS-LQ1500	895.00
Epson JX80 Color printer	EPS-JX80	519.00
Prowriter 8510 parallel 9½" paper	PRO-8510P	329.00
Dataproducts B-600-3, band printer 600 LPM.	DPS-B600	6985.00
Printronix P300 high speed printer 300 lines per minute.	PTX-P300	3995.00
Printronix P600 ultra high speed 600 lines per minute.	PTX-P600	5795.00

WORD PROCESSING PRINTERS

Starwriter F10 parallel, 40 char/sec.	PRO-F10P	499.00
NEC8810 55 char/second, serial interface	NEC-8810	1659.00
NEC8830 55 char/sec, par'l interface.	NEC-8830	1659.00
NEC3550 popular printer designed for the IBM/PC	NEC-3550	1599.00
NEC2050 designed for IBM/PC 20 char/sec. par'l.	NEC-2050	689.00
Silver Reed EXP500, 14 char/sec. par'l interface	SRD-EXP500	319.00
Silver Reed EXP550 17 Char/sec par'l interface.	SRD-EXP550	429.00
Diablo 630 40 char/sec. serial	DBL-630	1569.00
Diablo 620, proportional spacing, horz.& vert. tab. 20 cps.	DBL-620	769.00
Juki 6100, 18 char./sec.	JUK-6100	399.00
Juki 6300, 40 char./sec.	JUK-6300	699.00
Comrex CR2, 5k buffer, proportional spacing, par'l.	CRX-CR2P	395.00



Shipping: First five pounds $3.00, each additional pound $.50.
Foreign orders: 10% shipping, excess will be refunded.
California residents add 6½% sales tax. ● COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.



What the world really needs is a 69 cent Double Sided, Double Density Diskette with a LIFETIME WARRANTY!

And DISK WORLD! has it.

Introducing Super Star Diskettes: the high quality diskette with the lowest price and the best LIFETIME WARRANTY!

In the course of selling more than a million diskettes every month, we've learned something: higher prices don't necessarily mean higher quality.

In fact, we've found that a good diskette manufacturer simply manufactures a good diskette...no matter what they charge for it. (By way of example, consider that none of the brands that we carry has a return rate of greater than 1/1,000th of 1 percent!)

In other words, when people buy a more expensive diskette, they aren't necessarily buying higher quality.

The extra money might be going toward flashier advertising, snazzier packaging or simply higher profits.

But the extra money in a higher price isn't buying better quality.

All of the good manufacturers put out a good diskette. Period.

How to cut diskette prices ...without cutting quality.

Now this discovery posed a dilemma: how to cut the price of diskettes without lowering the quality.

There are about 85 companies claiming to be "diskette" manufacturers.

Trouble is, most of them aren't manufacturers.

Rather they are fabricators or marketers, taking other company's components, possibly doing one or more steps of the processing themselves and pasting their labels on the finished product.

The new IBM diskettes, for example, are one of these. So are IBM 5¼" diskettes. Same for DYSAN, Polaroid and many, many other familiar diskette brand names. Each of these diskettes is manufactured in whole or in part by another company!

So, we decided to act just like the big guys. That's how we would cut diskette prices...without lowering the quality.

We would go out and find smaller companies to manufacture a diskette to our specifications...specifications which are higher than most...and simply create our own "name brand" diskette.

Name brand diskettes that offered high quality at low prices.

SUPER STAR DISKETTES ★

5¼" SSDD .55 ea. Qty. 50

5¼" DSDD .69 ea. Qty. 50

Super Star diskettes are sold in multiples of 50 only. Diskettes are shipped with white Tyvec sleeves, reinforced hubs, user ID labels and write-protect tabs.

Boy, did we get lucky. Our Super Star Diskettes are the same ones you've been using for years...without knowing it.

In our search for the low priced, high quality diskette of our dreams, we found something even more interesting.

We found that there are several manufacturers who don't give a hoot about the consumer market for their diskettes. They don't spend millions of dollars in advertising trying to get you, the computer user, to use their diskettes.

Instead, they concentrate their efforts on turning out the highest quality diskettes they can...because they sell them to the software publishers, computer manufacturers and other folks who (in turn) put their name on them...and sell them for much higher prices to you!

After all, when a software publisher or computer manufacturer or diskette marketer puts their name on a diskette, they want it to work time after time, everytime. (Especially software publishers who have the nasty habit of copy-protecting their originals!)

Super Star Diskettes. You already know how good they are. Now you can buy them...cheap.

Well, that's the story.

Super Star diskettes don't roll off the boat from Pago-Pago or emerge from a basement plant just east of Nowhere.

Super Star diskettes have been around fo[illegible]...and you've used them for years as copy-[illegible] software originals, unprotected originals. So[illegible] depending on which computer you own, the sy[illegible] may have been on a Super Star diskette. And [illegible] e than once, you've bought a box or two or more of [illegible] Star diskettes without knowing it. They just had some "big" company's name on them.

Super Star Diskettes are good. So good that a lot of major software publishers, computer manufacturers and other diskette marketers buy them in the tens or hundreds of thousands.

We buy them in the millions.

And than we sell them to you.

Cheap.

When every little bit counts, it's Super Star Diskettes.

You've used them a hundred times...under different names.

Now, you can buy the real McCoy, the same diskette that major software publishers, computer manufacturers and diskette marketers buy...and call their own.

We simply charge less.

FRAUD ALERT!

Please be careful!

A lot of the "no-name" diskettes flooding the market at prices of less than $1.00 are what we in the industry call "floor sweepings."

In other words, they're garbage...stuff that six months ago, no self-respecting manufacturer would have sold.

But times got tough and some people's scruples got a little lost in desperation...and so a lot of computer users are getting some really bad disks...and that isn't bargain at all.

So, when the price seems too good to be true...like 39 cents, be careful...very careful!

HOURS:
Human: 8AM-6PM Central Time, Monday through Friday

HOW TO ORDER:

ORDERS ONLY:
1-800-621-6827
(In Illinois: 1-312-256-7140)
INQUIRIES:
1-312-256-7140

FOR FASTEST SERVICE, USE NO-COST MCI MAIL: Our address is DISKORDER. It's a FREE MCI MAIL letter. No charge to you. (Situation permitting, we'll ship these orders in 24 hours or less.)

SHIPPING: 5¼" & 3½" DISKETTES—Add $3.00 per each 100 or fewer diskettes. **OTHER ITEMS:** Add shipping charges as shown in addition to other shipping charges. **PAYMENT:** VISA, MASTERCARD and Prepaid orders accepted. **COD ORDERS:** Add additional $5.00 special handling charge. **APO, FPO, AK, HI & PR ORDERS:** Include shipping charges as shown and additional 5% of total order amount to cover PAL and insurance. We ship only to United States addresses, except for those listed above. **TAXES:** Illinois residents, add 7% sales tax.

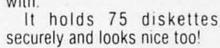
MINIMUM ORDER: $35.00.

Super Special!

Store 75 diskettes for only $5.95!



Yep, that's right: order 50 Super Star diskettes, add $5.95 and we'll include a Media Products DISK MINDER II...a well made unit that we're impressed with.



It holds 75 diskettes securely and looks nice too!

The Super Star LIFETIME WARRANTY!

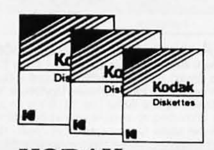
Super Star Diskettes are unconditionally warranted against defects in original material and workmanship so long as owned by the original purchaser. Returns are simple: just send the defective diskettes with proof of purchase, postage-paid by you with a short explanation of the problem, and we'll send you the replacements. (Incidentally, coffee stained diskettes and diskettes with staples driven through them don't qualify as "defective".)

WE WILL MEET OR BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES SUBJECT TO THE SAME TERMS AND CONDITIONS.

DISK WORLD!, INC.

629 Green Bay Road
Wilmette, Illinois 60091

KODAK DISKETTES: Discover the future today!



KODAK.
THE NAME
SAYS IT ALL.

Take a Century of experience in coating products like photo film, add two brand-new state-of-the-art plants for manufacturing diskettes and you have something new: KODAK diskettes, a taste of the future.

Kodak spends more than three million dollars a day in research and development. They have more than 120,000 employees and manufacture and market more than 30,000 products.

But George Eastman said it best:

George Eastman, the founder of Eastman Kodak and the man who made it possible for everyone to have a family album expressed Kodak's philosophy almost a century ago: make "good goods!"

That's why we're so pleased to add KODAK diskettes to our line.

Great quality, great value!

For those of you who want a "brand name" diskette with top-of-the-line quality...without paying through the nose, the choice is simple: KODAK.

Of course, there's a LIFETIME WARRANTY!

Except as noted, all KODAK diskettes are packed in boxes of ten with Tyvec sleeves, user ID labels and write-protect tabs. Bulk packed diskettes are labelled as KODAK diskettes and are packed in 4 bundles of 25 diskettes with Tyvec sleeves, user ID labels and write-protect tabs.

	Qty. 20-40	Qty. 60+	Qty. 100
5.25" SSDD	$1.11 ea.	$1.01 ea.	
5.25" DSDD	$1.46 ea.	$1.33 ea.	
5.25" DSDD-HD	$3.47 ea.	$3.15 ea.	
3.5" KODAK DISKETTES			
3.50" SSDD	$2.06 ea.	$1.87 ea.	
3.50" DSDD	$2.73 ea.	$2.48 ea.	

KODAK LABELLED BULK DISKETTES

5.25" SSDD in package of 100 .... $ .93
5.25" DSDD in package of 100 .... $1.24

FOR ORDERS ONLY: **1-800-621-6827** (In Illinois: 1-312-256-7140)
INFORMATION & INQUIRIES: **1-312-256-7140**
HOURS: 8AM-5PM Central Time, Monday-Friday
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DISK WORLD!, Inc.
629 Green Bay Road • Wilmette, Illinois 60091

DISK WORLD!



FANTASTIC LOW PRICES ON BASF QUALIMETRIC DISKETTES!

qualimetric

LIFETIME WARRANTY!

Buy in bulk and save. 150 to the carton with envelopes, write-protect tabs and user ID labels. Boxed product is the same, except in cardboard boxes of 10.

	Qty. 50	Qty. 150
5.25" SSDD	.83 ea.	.80 ea.
5.25" DSDD	.94 ea.	.92 ea.
5.25" DSDD-HD	2.13 ea.	N/A
5.25" SSDD-96TPI	.94 ea.	N/A
5.25" DSDD-96TPI	1.06 ea.	N/A
3.50 SSDD-135TPI	1.84 ea.	1.68 ea.
3.50 DSDD-135TPI	2.40 ea.	2.28 ea.

NOTE: 3.50" diskettes in Quantity 50 are packed in plastic library cases. That's why they seem to be a better buy. But there are only 5 diskettes to a case...so the bulk diskettes are really a better deal, unless you like expensive little library cases.

FOR ORDERS ONLY: **1-800-621-6827** (In Illinois: 1-312-256-7140)
INFORMATION & INQUIRIES: **1-312-256-7140**
HOURS: 8AM-6PM Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!

DISK WORLD! Authorized Reseller Information Processing Media **BASF**

Now, the lowest prices ever on 3M diskettes. LIFETIME WARRANTY!



All 3M diskettes are factory packed in boxes of 10 and come with Tyvec sleeves, user ID labels and write-protect tabs.

		Qty. 20-40	Qty. 50+
5.25"	SSDD	$1.20 ea.	$1.09 ea.
5.25"	DSDD	$1.70 ea.	$1.54 ea.
5.25"	SSDD-96TPI	$2.18 ea.	$1.98 ea.
5.25"	DSDD	$2.73 ea.	$2.48 ea.
5.25"	DSDD-HD	$3.45 ea.	$3.14 ea.
3.50"	SSDD	$2.18 ea.	$1.98 ea.
3.50"	DSDD	$3.09 ea.	$2.81 ea.

3M DATA CARTRIDGES
(Sold 10 to a carton only.)
(Add $5.00 shipping charges for cartridges!)

DC1000	$12.43 ea.
DC300XLP	$19.09 ea.
DC600A	$20.30 ea.

DISK WORLD! Authorized Distributor Information Processing Products



DISK WORLD! Ordering & Shipping Instructions

Shipping: 5¼" & 3.5" DISKETTES—Add $3.00 per each 100 or fewer diskettes. **Other Items:** Add shipping charges as shown in addition to other shipping charges. **Payment:** VISA and MASTERCARD accepted. **COD Orders:** Add additional $5.00Special Handling charge. **APO, FPO, AK, HI & PR Orders:** Include shipping charges as shown **and** additional 5% of total order amount to cover PAL and insurance. **Taxes:** Illinois residents only, add 7% sales tax.

Prices subject to change without notice.
This ad supercedes all other ads.
Not responsible for typographical errors.
MINIMUM TOTAL ORDER: $35.00

FOR ORDERS ONLY: **1-800-621-6827** (In Illinois: 1-312-256-7140)
INFORMATION & INQUIRIES: **1-312-256-7140**
HOURS: 8AM-6PM Central Time Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!
DISK WORLD!, Inc.
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DISK WORLD!

PRINTER RIBBONS: at extraordinary prices!

Brand new ribbons, manufactured to Original Equipment Manufacturer's specifications, in housings. (Not re-inked or spools only.)

LIFETIME WARRANTY!

Epson MX-70/80 .. **$2.70** ea. + 25¢ Shpng.
Epson MX-100 .... **$4.08** ea. + 25¢ Shpng.
Okidata Micro83 .. **$1.37** ea. + 25¢ Shpng.
Okidata Micro84 .. **$2.98** ea. + 25¢ Shpng.

FOR ORDERS ONLY: **1-800-621-6827** (In Illinois: 1-312-256-7140)
INFORMATION & INQUIRIES: **1-312-256-7140**
HOURS: 8AM-6PM Central Time, Monday-Friday
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE ON THE SAME PRODUCTS AND QUANTITIES!
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DISK WORLD!

ATHANA DISKETTES The great unknown!

60¢ ea. ← 5¼" SSDD Qty. 50
74¢ ea. 5¼" DSDD → Qty. 50

You've used these diskettes hundreds of times...as copy-protected originals on some of the most popular software packages. They're packed in poly-bags of 25 with Tyvek sleeves, reinforced hubs, user identification labels and write-protect tabs.

LIFETIME WARRANTY!

SOFT SECTOR ONLY! Sold in multiples of 50 only.

FOR ORDERS ONLY: **1-800-621-6827** (In Illinois: 1-312-256-7140)
INFORMATION & INQUIRIES: **1-312-256-7140**
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DISK WORLD! Authorized Distributor ATHANA MAGNETIC MEDIA

DISKETTE STORAGE CASES

AMARAY MEDIA-MATE 50: A REVOLUTION IN DISKETTE STORAGE

Every once in a while, someone takes the simple and makes it elegant! This unit holds 50 5¼" diskettes, has grooves for easy stacking, inside nipples to keep diskettes from slipping and several other features. We like it! **$9.69** ea. + $2.00 Shpng.

DISKETTE 70 STORAGE: STILL A GREAT BUY.



Dust-free storage for 70 5¼" diskettes. Six dividers included. An excellent value. **$9.95** + $3.00 Shpng.

DISK CADDIES

The original flip-up holder for 10 5¼" diskettes. Beige or grey only. **$1.65** ea. + 20¢ Shpng.

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Worldwide • Since 1974
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COMMODORE® COMPATIBLE ACCESSORIES



RS232 Adapter for VIC-20 and Commodore 64

The JE232CM allows connection of standard serial RS232 printers, modems, etc. to your VIC-20 and C-64. A 4-pole switch allows the inversion of the 4 control lines. Complete installation and operation instructions included.
· Plugs into User Port · Provides Standard RS232 signal levels · Uses 6 signals (Transmit, Receive, Clear to Send, Request to Send, Data Terminal Ready, Data Set Ready).

JE232CM. $39.95

Voice Synthesizer VIC-20 & C-64
Plug-In – Talking in Minutes!
JE520CM. $99.95

300 Baud Auto Modem
Mitey-Mo (For C-64). **$74.95**

Parallel Printer Interface
FREE 4K Buffer Included!
MW350 (For VIC-20, C-64 & C-128). **$69.95**

TRS-80 COMPATIBLE ACCESSORIES

E-X-P-A-N-D TRS-80 MEMORY
All kits come complete with documentation

TRS-80 MODEL I, III
TRS-16K3 200ns (Model III). $5.95
TRS-16K4 250ns (Model I). $5.49

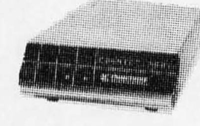
TRS-80 COLOR AND COLOR II
TRS-64K-2. . . . . $9.95

TRS-80 MODEL 4, 4P
TRS-64K-2. . . . . $9.95
Expands Model 4 from 16K-64K or Model 4P from 64K-128K
TRS-64K-2PAL. $29.95
Expands Model 4 from 64K to 128K

TRS-80 Model 100 • NEC • OLlivetti
M1008K. . . . . $29.95 ea. or 3 for $79.95
TRS-80 Model 100 Expansion
NEC8KR. . . . . $29.95 ea. or 3 for $79.95
NEC Model PC-8201A Expansion
OM108K. . . . . $29.95 ea. or 3 for $79.95
Olivetti Model M10 Expansion

TANDY 200
M200R. . . . . $99.95 ea. or 2 for $189.95
Tandy Model 200 Expansion

PROMETHEUS MODEMS



Intelligent 1200/300 Baud Modem with Real Time Clock/Calendar

The ProModem™ is a Bell 212A (1200/300) intelligent stand-alone modem · Hayes command set compatible plus an additional extended command set · Shown with alphanumeric display option. **RS-232 Stand-Alone Unit:**

PM1200. . . . . $299.95

Options for ProModem 1200
PM-COM. $79.95
ProCom Communications Software. Please specify Operating System – Apple: ProDOS or CP/M – IBM: PC DOS or MS DOS
PM-OP512K. $129.95
Communications Buffer Option
BUF512K. $54.95
512K Memory for PM-OP512K
PM-ALP. $79.95
Alphanumeric Display for ProModem 1200
PM-SPECIAL #2. . . . . $249.95
Includes PM-OP512K, BUF512K and PM-ALP

APPLE® COMPATIBLE ACCESSORIES

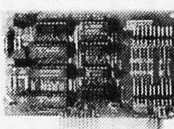
All Apple Cards come complete with instructions. ***MADE IN THE USA!***

16K RAM CARD (Language Card)
For Apple II and II+*



Expand from 48K-64K. Runs AppleSoft, DOS, CP/M and Pascal. **(ARC-16K/MEM-1)**
JE860 . . $39.95**

CONTROLLER CARD
For Apple II, II+ and *II*e*



Capable of handling up to two drives. Recommended drives: ADD-514 or ADD-12. **(ACC-1)**
JE875 . . . . $49.95

80-COLUMN PLUS 64K RAM
For Apple *II*e*

JE864 doubles the amount of data the Apple *II*e can display, and memory capacity too.
JE864 . . . . $69.95



128K RAM CARD
For Apple II, II+ and *II*e*
Five key software programs are included: Memory Management System, Utilities, Diagnostics, Demos, and RAM Disk Emulators for DOS 3.3, CP/M & Apple Pascal. Features DOS relocator. **Expand-A-RAM:**
JE868. . . . . . . $119.95**

PROMETHEUS

APPLESURANCE DIAGNOSTIC DISK CONTROLLER CARD
For Apple II, II+ and *II*e*
PREVENTS CRASHES!
Test your RAM, ROM, CPU and Disk Drives.
DRV-1/Applesurance II:
JE877. . . . . $69.95

PROMETHEUS

PARALLEL PRINTER CARD
For Apple II, II+ and *II*e*
Fully compatible with Apple CP/M, Apple Pascal (or FORTRAN), and most other operating systems and software packages. Available for Apple II, II+ and *II*e*. **PRT-1:**
JE880. . . . . $59.95

PROMETHEUS

PARALLEL/SERIAL 64K BUFFER CARD
For Apple II, II+ and *II*e*
Using the parallel jumper cable supplied, the JE883 will attach to the JE880 (above). Parallel Card needed for operation. The JE883 includes a standard parallel input with both parallel and serial (RS232) buffered outputs. **P/S Buffer:**
JE883. . . . . $79.95

*APPLE, APPLE II, II+ and *II*e are registered trademarks of Apple Computers.
**When using CP/M, the JE860 and JE868 will only function with Version 2.20 or earlier: PASCAL (JE868) Version 1.1 or earlier.

ADDITIONAL APPLE* COMPATIBLE PRODUCTS
Key: a=Apple II or II+ b=Apple *II*e

APF-1	Cooling Fan with Surge Protection • Key: (a,b).	$ 39.95
KHP4007	Switching Power Supply • Key: (a,b).	$ 39.95
JE614	Numeric/Aux. Keypad - 11 accessible functions • Key: (b). . . .	$ 49.95
AMON	12" Green Monitor with Swivel Stand • Key: (a, b and *II*c).	$ 99.95
KB-EA1	Apple Keyboard and Case • Key: (a).	$ 99.95
JE520AP	Voice Synthesizer – Plug-In, User Ready • Key: (a,b).	$119.95
ADD-12	5¼" Half-Height Disk Drive • Key: (a,b).	$129.95
ADD-IIc	5¼" Half-Height Disk Drive • Key: (*II*c).	$129.95
ADD-514	5¼" Full Height Disk Drive • Key: (a,b).	$139.95
PM1200A	Prometheus Internal Modem – 2 Cards • Key: (a,b).	$299.95
PM1200M	Prometheus Macintosh Ext. Modem • Key: (Macintosh).	$349.95

GENERAL APPLICATION POWER SUPPLIES



Power/Mate Corp. REGULATED POWER SUPPLY
· Input: 105-125/210-250VAC @ 47-63Hz · Line regulation: ±0.05% · 3 mounting surfaces · Overvoltage protection · UL recognized · CSA certified

Part No.	Output	Size (Inches)	Weight	PRICE
EMA5/6B	5V@3A / 6V@2.5A	4⅞L x 4W x 2⅛H	2 lbs.	$29.95
EMA5/6C	5V@6A / 6V@5A	5⅝L x 4⅞W x 2⅞H	4 lbs.	$39.95



4-CHANNEL SWITCHING POWER SUPPLY
· Microprocessor, mini-computer, terminal, medical equipment and process control applications · Input: 90-130VAC, 47-440Hz · Output: +5VDC @ 5A, −5VDC @ 1A; +12VDC @ 1A, −12VDC @ 1A · Line regulation: ±0.2% · Ripple: 30mV p-p · Load regulation: ±1% · Overcurrent protection · Adjustment: 5V main output ± 10% · Size: 6⅜"L x 1⅞"W x 4-15/16"H · Weight: 1½ lbs.
FCS-604A. $59.95

IBM® COMPATIBLE ACCESSORIES

Build an IBM PC/XT Compatible!
- 8 Card Slots
- Flip-Up Lid
- All necessary hardware for expansion is included
- Weight: 17 lbs.

IBM-Case. $59.95

Additional Add-Ons Available!

IBM-KB	Keyboard.	$ 79.95
IBM-FCC	Disk Controller.	$ 59.95
IBM-MCC	Monochrome Card.	$ 89.95
IBM-MON	12" Monochr. Monitor. . . .	$109.95
IBM-5151	Keyboard. . . . . (Equivalent to Keytronics™ 5151)	$ 99.95
IBM-ICB	Color Card. . . . . (With Printer Port)	$109.95
IBM-E384K	384K RAM Card.	$169.95
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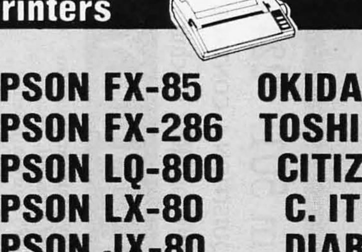
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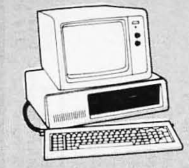
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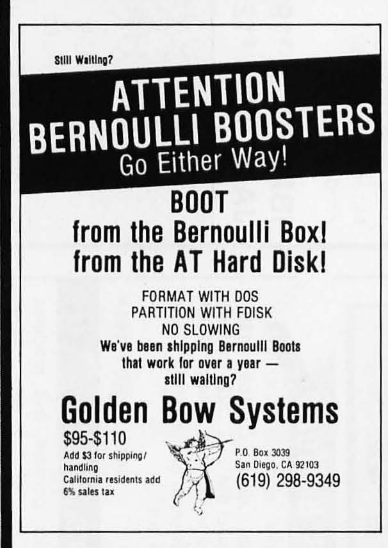
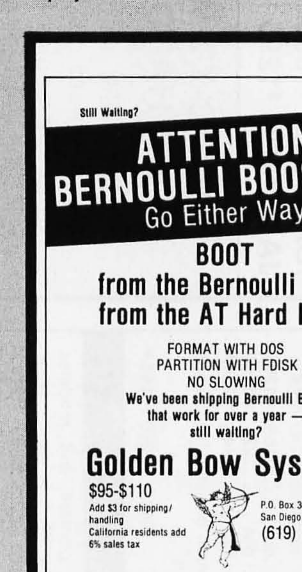
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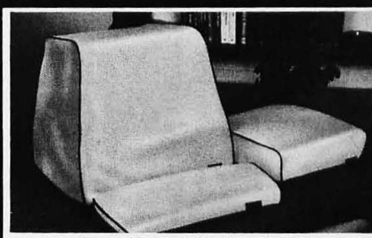
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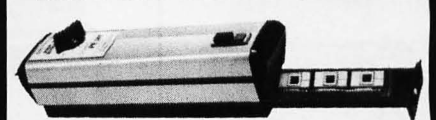
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74LS12	.22	74LS195	.69
74LS13	.26	74LS196	.59
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74LS30	.17	74LS245	.79
74LS32	.18	74LS251	.49
74LS33	.28	74LS253	.49
74LS37	.26	74LS256	1.79
74LS38	.26	74LS257	.39
74LS42	.39	74LS258	.49
74LS47	.59	74LS259	1.29
74LS48	.69	74LS260	.49
74LS51	.17	74LS266	.39
74LS73	.29	74LS273	.79
74LS74	.24	74LS279	.39
74LS75	.29	74LS280	1.98
74LS76	.29	74LS283	.59
74LS83	.49	74LS290	.89
74LS85	.49	74LS293	.89
74LS86	.22	74LS299	1.49
74LS90	.39	74LS322	3.95
74LS92	.49	74LS323	2.49
74LS93	.39	74LS364	1.95
74LS95	.49	74LS365	.39
74LS107	.34	74LS367	.39
74LS109	.36	74LS368	.39
74LS112	.29	74LS373	.79
74LS122	.45	74LS374	.79
74LS123	.49	74LS375	.95
74LS124	2.75	74LS377	.79
74LS125	.39	74LS378	1.18
74LS126	.39	74LS390	1.19
74LS132	.39	74LS393	.79
74LS133	.49	74LS541	1.49
74LS136	.39	74LS624	1.95
74LS138	.39	74LS640	.99
74LS139	.39	74LS645	.99
74LS145	.99	74LS669	1.29
74LS147	.99	74LS670	.89
74LS148	.99	74LS682	3.20
74LS151	.39	74LS683	3.20
74LS153	.39	74LS684	3.20
74LS154	1.49	74LS688	2.40
74LS155	.59	74LS783	22.95
74LS156	.49	81LS95	1.49
74LS157	.35	81LS96	1.49
74LS158	.29	81LS97	1.49
74LS160	.29	81LS98	1.49
74LS161	.39	25LS2521	2.80
74LS162	.49	25LS2569	2.80
74LS163	.39	26LS31	1.95
74LS164	.49	26LS32	1.95

HIGH SPEED CMOS

A new family of high speed CMOS logic featuring the speed of low power Schottky (8ns typical gate propagation delay), combined with the advantages of CMOS: very low power consumption, superior noise immunity, and improved output drive.

74HC00

74HC: Operate at CMOS logic levels and are ideal for new, all-CMOS designs.

74HC00	.59	74HC148	1.19
74HC02	.59	74HC151	.89
74HC04	.59	74HC154	2.49
74HC08	.59	74HC157	.89
74HC10	.59	74HC158	.95
74HC14	.79	74HC163	1.15
74HC20	.59	74HC175	.99
74HC27	.59	74HC240	1.89
74HC30	.59	74HC244	1.89
74HC32	.69	74HC245	1.89
74HC51	.59	74HC257	.85
74HC74	.75	74HC259	1.39
74HC85	1.35	74HC273	1.89
74HC86	.69	74HC299	4.99
74HC93	1.19	74HC368	.99
74HC107	.79	74HC373	2.29
74HC109	.79	74HC374	2.29
74HC112	.79	74HC390	1.39
74HC125	1.19	74HC393	1.39
74HC132	1.19	74HC4017	1.99
74HC133	.69	74HC4020	1.39
74HC138	.99	74HC4049	.89
74HC139	.99	74HC4050	.89

74HCT00

74HCT: Direct, drop-in replacements for LS TTL and can be intermixed with 74LS in the same circuit.

74HCT00	.69	74HCT166	3.05
74HCT02	.69	74HCT174	1.09
74HCT04	.69	74HCT193	1.39
74HCT08	.69	74HCT194	1.19
74HCT10	.69	74HCT240	2.19
74HCT11	.69	74HCT241	2.19
74HCT27	.69	74HCT244	2.19
74HCT30	.69	74HCT245	2.19
74HCT32	.79	74HCT257	.99
74HCT74	.85	74HCT259	1.59
74HCT75	.95	74HCT273	2.09
74HCT138	1.15	74HCT367	1.09
74HCT139	1.15	74HCT373	2.49
74HCT154	2.99	74HCT374	2.49
74HCT157	.99	74HCT393	1.59
74HCT158	.99	74HCT4017	2.19
74HCT161	1.29	74HCT4040	1.59
74HCT164	1.39	74HCT4060	1.49

74F00

74F00	.69	74F74	.79	74F251	1.69
74F02	.69	74F86	.99	74F253	1.69
74F04	.79	74F138	1.69	74F257	1.69
74F08	.69	74F139	1.69	74F280	1.79
74F10	.69	74F157	1.69	74F283	3.95
74F32	.69	74F240	3.29	74F373	4.29
74F64	.89	74F244	3.29	74F374	4.29

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CMOS

4001	.19	14419	4.95
4011	.19	14433	14.95
4012	.25	4503	.49
4013	.35	4511	.69
4015	.29	4516	.79
4016	.29	4518	.85
4017	.49	4522	.79
4018	.69	4526	.79
4020	.59	4527	1.95
4021	.69	4528	.79
4024	.49	4529	2.95
4025	.25	4532	1.95
4027	.39	4538	.95
4028	.65	4541	1.29
4035	.69	4553	5.79
4040	.69	4585	.75
4041	.75	4702	12.95
4042	.59	74C00	.29
4043	.85	74C14	.59
4044	.69	74C74	.59
4045	1.98	74C83	1.95
4046	.69	74C85	1.49
4047	.69	74C95	.99
4049	.29	74C150	5.75
4050	.29	74C151	2.25
4051	.69	74C161	.99
4052	.69	74C163	.99
4053	.69	74C164	1.39
4056	2.19	74C192	1.49
4060	.69	74C193	1.49
4066	.29	74C221	1.75
4069	.19	74C240	1.89
4076	.59	74C244	1.89
4077	.29	74C374	1.99
4081	.22	74C905	10.95
4085	.79	74C911	8.95
4086	.89	74C917	8.95
4093	.49	74C922	4.49
4094	2.49	74C923	4.95
14411	9.95	74C926	7.95
14412	6.95	80C97	.95

7400/9000

7400	.19	74147	2.49
7402	.19	74148	1.20
7404	.19	74150	1.35
7406	.29	74151	.55
7407	.29	74153	.55
7408	.24	74154	1.49
7410	.19	74155	.75
7411	.25	74157	.55
7414	.49	74159	1.65
7416	.25	74161	.69
7417	.25	74163	.69
7420	.19	74164	.85
7423	.29	74165	.85
7430	.19	74166	1.00
7432	.29	74175	.89
7438	.29	74177	.75
7442	.49	74178	1.15
7445	.69	74181	2.25
7447	.89	74182	.75
7470	.35	74184	2.00
7473	.34	74191	1.15
7474	.33	74192	.79
7475	.45	74194	.85
7476	.35	74196	.79
7483	.50	74197	.75
7485	.59	74199	1.35
7486	.35	74221	1.35
7489	2.15	74246	1.35
7490	.39	74247	1.25
7492	.50	74248	1.85
7493	.35	74249	1.95
7495	.55	74251	.75
7497	2.75	74265	1.35
74100	2.29	74273	1.95
74121	.29	74278	3.11
74123	.49	74367	.65
74125	.45	74368	.65
74141	.65	9368	3.95
74143	5.95	9602	1.50
74144	2.95	9637	2.95
74145	.60	96S02	1.95

74S00

74S00	.29	74S163	1.29
74S02	.29	74S168	3.95
74S03	.29	74S174	.79
74S04	.29	74S175	.79
74S05	.29	74S188	1.95
74S08	.35	74S189	1.95
74S10	.29	74S195	1.49
74S15	.35	74S196	1.49
74S30	.29	74S197	1.49
74S32	.35	74S226	3.99
74S37	.69	74S240	1.49
74S38	.69	74S241	1.49
74S74	.49	74S244	1.49
74S85	.95	74S257	.79
74S86	.35	74S253	.79
74S112	.50	74S258	.95
74S124	2.75	74S280	1.95
74S138	.79	74S287	1.69
74S140	.55	74S288	1.69
74S151	.79	74S299	2.95
74S153	.79	74S373	1.69
74S157	.79	74S374	1.69
74S158	.95	74S471	4.95
74S161	1.29	74S571	2.95

DATA ACQ / INTERFACE

DATA ACQ		INTERFACE	
ADC0800	15.55	8T26	1.29
ADC0804	3.49	8T28	1.29
ADC0809	4.49	8T95	.89
ADC0816	14.95	8T96	.89
ADC0817	9.95	8T97	.59
ADC0831	8.95	8T98	.89
DAC0800	4.49	DM8131	2.95
DAC0806	1.95	DP8304	2.29
DAC0808	2.95	DS8833	2.25
DAC1020	8.25	DS8835	1.99
DAC1022	5.95	DS8836	.99
MC1408L8	2.95	DS8837	1.65

VOLTAGE REGULATORS

TO-220 CASE

7805T	.49	7905T	.59
7808T	.49	7908T	.59
7812T	.49	7912T	.59
7815T	.49	7915T	.59

TO-3 CASE

7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49

TO-92 CASE

78L05	.49	79L05	.69
78L12	.49	79L12	.69

OTHER VOLTAGE REGS

LM323K	5V 3A	TO-3	4.79
LM338K	Adj. 5A	TO-3	3.95
78H05K	5V 5A	TO-3	7.95
78H12K	12V 5A	TO-3	8.95
78P05K	5V 10A	TO-3	14.95

IC SOCKETS

	1-99	100
8 PIN ST	.13	.11
14 PIN ST	.15	.12
16 PIN ST	.17	.13
18 PIN ST	.20	.18
20 PIN ST	.29	.27
22 PIN ST	.30	.27
24 PIN ST	.30	.27
28 PIN ST	.40	.32
40 PIN ST	.49	.39
64 PIN ST	4.25	CALL
ST=SOLDERTAIL		
8 PIN WW	.59	.49
14 PIN WW	.69	.52
16 PIN WW	.69	.58
18 PIN WW	.99	.90
20 PIN WW	1.09	.98
22 PIN WW	1.39	1.28
24 PIN WW	1.49	1.35
28 PIN WW	1.69	1.49
40 PIN WW	1.99	1.80
WW=WIREWRAP		
16 PIN ZIF	4.95	CALL
24 PIN ZIF	5.95	CALL
28 PIN ZIF	6.95	CALL
40 PIN ZIF	9.95	CALL
ZIF=TEXTOOL (ZERO INSERTION FORCE)		

LINEAR

TL066	.99	LM733	.98
TL071	.69	LM741	.29
TL072	1.09	LM747	.69
TL074	1.95	LM748	.59
TL081	.59	MC1330	1.69
TL082	.99	MC1350	1.19
TL084	1.49	MC1372	6.95
LM301	.34	LM1414	1.59
LM309K	1.25	LM1458	.49
LM311	.59	LM1488	.49
LM311H	.89	LM1489	.49
LM317K	3.49	LM1496	.85
LM317T	.95	LM1812	8.25
LM318	1.49	LM1889	1.95
LM319	1.25	ULN2003	.79
LM320	see 7900	XR2206	3.75
LM322	1.65	XR2211	2.95
LM323K	4.79	XR2240	1.95
LM324	.49	MPQ2907	1.95
LM331	3.95	LM2917	1.95
LM334	1.19	CA3046	.89
LM335	1.40	CA3081	.99
LM336	1.75	CA3082	.99
LM337K	3.95	CA3086	.80
LM338K	3.95	CA3089	1.95
LM339	.59	CA3130E	.99
LM340	see 7800	CA3146	1.29
LM350T	4.60	CA3160	1.19
LF353	.59	MC3470	1.95
LF356	.99	MC3480	8.95
LF357	.99	MC3487	2.95
LM358	.59	LM3900	.49
LM380	.89	LM3909	.98
LM383	1.95	LM3911	2.25
LM386	.89	LM3914	2.39
LM393	.45	MC4024	3.49
LM394H	4.60	MC4044	3.99
TL494	4.20	RC4136	1.25
TL497	3.25	RC4558	.69
NE555	.29	LM13600	1.49
NE556	.49	75107	1.49
NE558	1.29	75110	1.95
NE564	1.95	75150	1.95
LM565	.95	75154	1.95
LM566	1.49	75188	1.25
LM567	.79	75189	1.25
NE570	2.95	75451	.39
NE590	2.50	75452	.39
NE592	.98	75453	.39
LM710	.75	75477	1.29
LM723	.49	75492	.79

H=TO-5 CAN, K=TO-3, T=TO-220

EDGECARD CONNECTORS

100 PIN ST	S-100	.125	3.95
100 PIN WW	S-100	.125	4.95
62 PIN ST	IBM PC	.100	1.95
50 PIN ST	APPLE	.100	2.95
44 PIN ST	STD	.156	1.95
44 PIN WW	STD	.156	4.95

36 PIN CENTRONICS

MALE		
IDCEN36	RIBBON CABLE	6.95
CEN36	SOLDER CUP	4.95
CEN36PC	RT ANGLE PC MOUNT	4.95
FEMALE		
IDCEN36/F	RIBBON CABLE	7.95

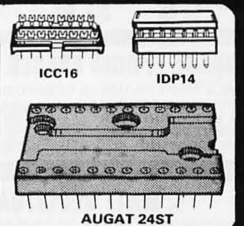
INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	4.95
ICM7207A	5.95
ICM7208	15.95

DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxxST	.62	.79	.89	1.09	1.29	1.39	1.49	1.69	2.49
HIGH RELIABILITY TOOLED WW IC SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40
COMPONENT CARRIES (DIP HEADERS)	ICCxx	.49	.59	.69	.99	.99	.99	.99	1.09	1.49
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	---	.95	.95	---	---	---	1.75	---	2.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE BELOW



DIODES/OPTO/TRANSISTORS

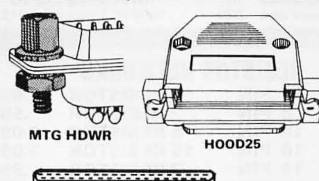
1N751	.25	4N26	.69
1N759	.25	4N27	.69
1N4148	25/1.00	4N28	.69
1N4004	10/1.00	4N33	.89
1N5402	.25	4N37	1.19
KBP04	.55	MCT-2	.59
KBU8A	.95	MCT-6	1.29
MDA990-2	.35	TIL-111	.99
N2222	.25	2N3906	.10
PN2222	.10	2N4401	.25
2N2905	.50	2N4402	.25
2N2907	.25	2N4403	.25
2N3055	.79	2N6045	1.75
2N3904	.10	TIP31	.49

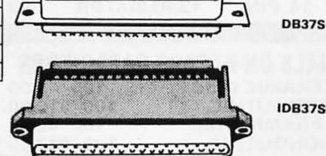
D-SUBMINIATURE

DESCRIPTION		ORDER BY	CONTACTS 9	15	19	25	37	50
SOLDER CUP	MALE	DBxxP	.82	.90	1.25	1.25	1.80	3.48
	FEMALE	DBxxS	.95	1.15	1.50	1.50	2.35	4.32
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	1.20	1.49	---	1.95	2.65	---
	FEMALE	DBxxSR	1.25	1.55	---	2.00	2.79	---
WIRE WRAP	MALE	DBxxPWW	1.69	2.56	---	3.89	5.60	---
	FEMALE	DBxxSWW	2.76	4.27	---	6.84	9.95	---
IDC RIBBON CABLE	MALE	IDBxxP	2.70	2.95	---	3.98	5.70	---
	FEMALE	IDBxxS	2.92	3.20	---	4.33	6.76	---
HOODS	METAL	MHOODxx	1.25	1.25	1.30	1.30	---	---
	GREY	HOODxx	.65	.65	---	.65	.75	.95

ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED.
EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15PR.

MOUNTING HARDWARE $1.00





LED DISPLAYS

FND-357(359)	COM CATHODE	.362"	1.25
FND-500(503)	COM CATHODE	.5"	1.49
FND-507(510)	COM ANODE	.5"	1.49
MAN-72	COM ANODE	.3"	.99
MAN-74	COM CATHODE	.3"	.99
MAN-8940	COM CATHODE	.8"	1.99
TIL-313	COM CATHODE	.3"	.45
HP5082-7760	COM CATHODE	.43"	1.29
TIL-311	4x7 HEX W/LOGIC	.270"	9.95
HP5082-7340	4x7 HEX W/LOGIC	.290"	7.95

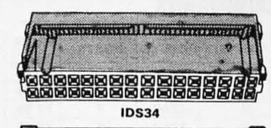
DIFFUSED LEDS

		1-99	100-UP
JUMBO RED	T1¾	.10	.09
JUMBO GREEN	T1¾	.14	.12
JUMBO YELLOW	T1¾	.14	.12
MOUNTING HDW	T1¾	.10	.09
MINI RED	T1	.10	.09

IDC CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS 10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	.79	.99	1.39	1.59	1.99	2.25
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	1.75	2.25	2.65	2.75	3.80	3.95

FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE ABOVE



SWITCHES

SPST	MINI-TOGGLE ON-ON	1.25
DPDT	MINI-TOGGLE ON-ON	1.50
DPDT	MINI-TOGGLE ON-OFF-ON	1.75
SPST	MINI-PUSHBUTTON N.O.	.39
SPST	MINI-PUSHBUTTON N.C.	.39
SPST	TOGGLE ON-OFF	.49
BCD OUTPUT 10 POSITION 6 PIN DIP		1.95

DIP SWITCHES

4 POSITION	.85	7 POSITION	.95
5 POSITION	.90	8 POSITION	.95
6 POSITION	.90	10 POSITION	1.29

HARD TO FIND "SNAPABLE" HEADERS

CAN BE SNAPPED APART TO MAKE ANY SIZE HEADER, ALL WITH .1" CENTERS

1x40	STRAIGHT LEAD	.99
1x40	RIGHT ANGLE	1.49
2x40	STRAIGHT LEAD	2.49
2x40	RIGHT ANGLE	2.99

SHORTING BLOCKS

GOLD CONTACTS SPACED AT .1" CENTERS



5/$1.00

It was a pleasure to place an order with your people. I found the response pleasant and helpful and the answers prompt and correct. The delivery on my most recent order was fast, correct and well packed. I already had faith in the quality since my family has been using some of your products for several years with no problems.

Sincerely, J.D. Hattaway

RIBBON CABLE

CONTACTS	SINGLE COLOR 1'	SINGLE COLOR 10'	COLOR CODED 1'	COLOR CODED 10'
10	.18	1.60	.30	2.75
16	.28	2.50	.48	4.40
20	.36	3.20	.60	5.50
25	.45	4.00	.75	6.85
26	.46	4.10	.78	7.15
34	.61	5.40	1.07	9.35
40	.72	6.40	1.20	11.00
50	.89	7.50	1.50	13.25

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- ★ SHIELDED CABLE WITH GROUNDING LUG FOR EMI-FREE OPERATION

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PAGE WIRE WRAP WIRE

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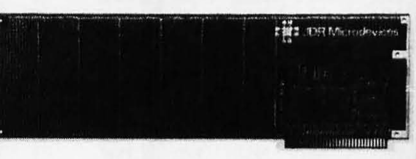
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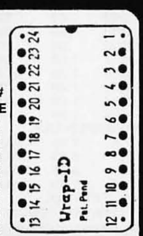
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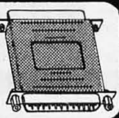


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27	50V	.05	.0022	50V	.05
33	50V	.05	.005	50V	.05
47	50V	.05	.01	50V	.07
68	50V	.05	.02	50V	.07
100	50V	.05	.05	50V	.07
220	50V	.05	.1	12V	.10
560	50V	.05	.1	50V	.12

MONOLITHIC

.01μf	50V	.14	.1μf	50V	.18
.047μf	50V	.15	.47μf	50V	.25

ELECTROLYTIC

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4.7	50V	.15	22	16V	.14
10	50V	.15	47	50V	.20
47	35V	.18	100	35V	.25
100	16V	.18	220	25V	.30
220	35V	.20	470	50V	.50
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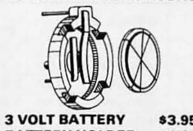
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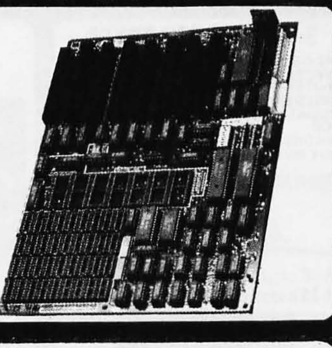
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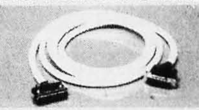
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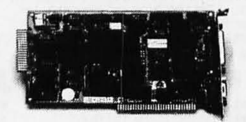
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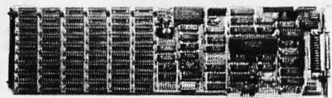
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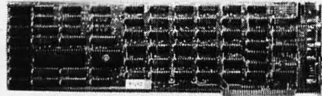


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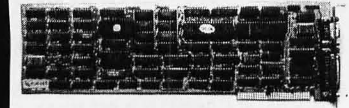
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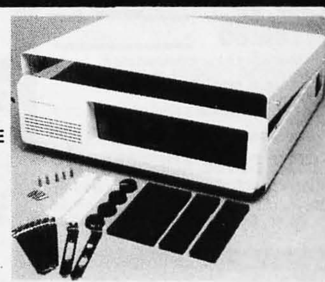
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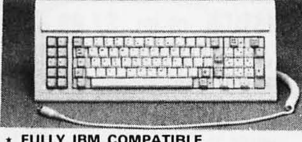


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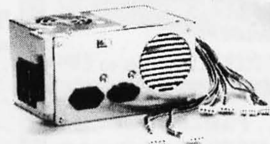
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WANTED: Nonprofit chemical-dependency treatment center seeks tax-deductible donation of computer, peripherals, and equipment for academic use. Prefer IBM, Apple, Commodore, or compatible. Will pay shipping and provide receipt. Robert Sundrud, Odyssey House of Louisiana, 1125 North Tonti St., New Orleans, LA 70119, (504) 821-9211.

WANTED: San Francisco Bay Area Council needs old video and computer equipment for regular cable TV show they produce called "Young Ideas." Tax-deductible. Keith St. Clare, Explorer Scouts and Boy Scouts of America, 150 2nd St., 5th Floor, San Francisco, CA 94105.

NEEDED: Nonprofit legal-aid organization seeks tax-deductible donation of TRS-80 Model 100 or Tandy 200 portable computer. Will pay shipping and provide receipt. Florida Institutional Legal Services Inc., 2614 Southwest 34th St., Gainesville, FL 32608, (904) 377-4212.

WANTED: Magic Computer Users Group or any Magic users interested in forming a users group. Together we can discover how to reconfigure the function keys. Dean H. Brailey, POB 16201, Lansing, MI 48901, (517) 372-0432.

WANTED: Two bezels to fit Siemens FDD 120-8 drives. Mine were destroyed by shippers. Might buy a couple of old drives for the needed parts. O. K. Hudson, POB 68, New Strawn, KS 66839, (316) 364-8635.

WANTED: Public-domain software for the IBM PC and compatibles. Send your list of programs. P. Rathod, Revefaret 4, 0491 Oslo 4, Norway.

NEEDED: Two parts for NCR I-9020 computer: AS 6090-F208 to add 256K memory and AK 6081-K901, a universal dynamic addressing translator. Julio Guzman, Constructora Lobeira, Monterey, Mexico, telephone: (011-5283) 77-7100 or 77-9615; Telex 382132 MOTIME.

FOR SALE: Conographic Cono-Color 40 adapter for IBM PC, Amdek Color IV video monitor with cable, and more: $1500. Teac model FD-55F disk drive for IBM PC: $150. Roland processing unit and interface card: asking $200. Terry Gilmore, Hatfield Village, AA2-12, Hatfield, PA 19440, (215) 855-0741.

FOR SALE: Slicer 80186 SBC: $2350. Apple II+ with 64K, dual floppies, 10-megabyte drive, SP-PP-CC MFC, 300/1200 modem, carry case, PROM burner, 80-column display, and more. All for $2250 or separately. Ed O'Neill, 633 Cotton Ave., Birmingham, AL 35211, (205) 787-4195.

FOR SALE: HP 82163A HP-IL video interface with all accessories and manual. As-new condition. $100 includes UPS. Steve Tedder, IITRI/NIPER, POB 2128, Bartlesville, OK 74005, (918) 337-4250.

FOR SALE: Tandon Half-Height 8-inch floppy-disk drive. Brand new. $95. Several hard-disk drives for IBM PC AT. Joowon Kim, 473 Sapena Court #11, Santa Clara, CA 95050, (408) 727-6995 or 378-1246.

WANTED: Formula 1 development system(s). Eric Rossi, EMAC, 1400 West Main St., Suite 5, Carbondale, IL 62901, (618) 529-4525.

FOR SALE: Apple IIe with 65C02 enhancement, one Disk II, IDS 480 printer, Taxan RGB Vision III monitor with RGB 64K extended 80-column card, Applemouse IIe, all cables, and more. Dan Rosenberg, 252 Spring Ridge Dr., Berkeley Heights, NJ 07922, (201) 464-5269.

WANTED: RCA 1802/Super Elf user seeks a copy of *Quest* 12K *Super Basic* and manual. Will pay reasonable price. Also interested in other 1802 software and correspondence with hobbyists still using the 1802. Douglas Connolly, 5415 Connecticut Ave. NW, Apt. 307, Washington, DC 20015, (202) 362-2089.

WANTED: Comrex ComFiler hard disk, 8000 series disk-formatted or other hard-disk drive for Epson QX-10. Americus Mitchell, POB 1335, Kilmarnock, VA 22482, (804) 435-3489.

WANTED: Manual and schematics for Xcomp S-100 hard-disk interface boards (or copies). Forrest Anderson, POB 31790, Phoenix, AZ 85046, (602) 863-9981.

FOR SALE: TI PC, two 320K drives, Persyst board, 256K main memory, 13-inch high-resolution color monitor, 3-plane graphics board, and 850 printer with tractor feed. David Pearl, R.R. 4, Box A-33, Warsaw, IN 46580, (219) 269-2744.

FOR TRADE: Hewlett-Packard Series 200 for IBM PC XT in good condition or PC XT hardware clone. Brandon Jones, 115 Home Estate Dr., Slidell, LA 70460, (504) 643-2329, evenings.

FOR SALE: BYTE: May 1977 through present. Excellent condition. $200 or best offer. Stewart Fleisher, 2000 South Logan, Denver, CO 80210, (303) 722-7247.

FOR SALE: Radio Shack 32K expansion interface for RS Model I, with cable: $150. One Tandy disk drive and one Teac disk drive for Model I, both in case and with power supply: $100 each. Perfect condition. R. Friedman, 495 East 18th St., Brooklyn, NY 11226, (718) 282-4029.

FOR SALE: Heathkit H-19 video terminal and Anderson Jacobson A-242A acoustic coupler. Asking $175, or will swap for HP 41CX calculator. Robert David, 975 Vallevista, Pittsburgh, PA 15234.

FOR SALE: Sorcerer II computer, disk display unit with two 77-track drives, S-100 expansion box, and extensive documentation. Asking $500. B. Walther, POB 58, Tam-Sui, Taiwan.

WANTED: Student of electrical engineering seeks old computer hardware. Will pay. Will also trade public-domain programs. T. Belding, POB 743, Granger, TX 76530-0743.

FOR SALE: California Computer Systems computer, CP/M, Z80, NEC 5500D Spinwriter, two Shugart 500K drives, Hazeltine 1420 monitor, and more: $3500. Bill Barto, 323 Haddon Ave., Westmont, NJ 08108, (609) 858-4201.

FOR SALE: CompuPro 20-slot computer, 68K CPU, 640K RAM, two Shugart SA851s, cabinet, power supply, and more: $2500. Dale Satterfield, 1122 Kelly Dr., San Jose, CA 95129, (415) 367-4421.

FOR SALE: Two Hewlett-Packard HP 87XMs, $900 each. Three HP 9130As, $290 each. Hard-disk unit, modules, ROMs and accessories. Don Person, Box 3103, Albany, NY 12203, (518) 482-9023.

NEEDED: Student seeks information on computer graphics. Jerzy Mityk, 25-531 Kielce, Rew Pazdz 47/139, Poland.

WANTED: Hewlett-Packard 16K memory module for HP 85A computer. Gordon Kirchhevel, POB 14172, Chicago, IL 60614, (312) 549-1475.

FOR SALE: Apple IIe, enhanced, Apple extended 80 card, Duodrive and controller, Grappler+ printer interface, Gemini-10X, Hayes micromodem IIe, Apple joystick, Monitor II, Commodore color monitor, and more. $1600. You pay shipping. Timmy Hu, 11 Benford Dr., Princeton Junction, NJ 08550.

FOR SALE: Two Teletype Model 33 ASRs with built-in reader and punch, RS-232C interface and pedestal, $90 each. Need a service technician or can barter above item for fix of a Reactron editing typewriter with IBM Selectric Printer. D. Test, POB 9064, North Newark, NJ 07104.

FOR SALE: Intel 80286 Microsystem Design Kit. Complete with 14 ICs and Intel data sheets including 80286, 80287, 82062, 8272A, 82730, 8207, 8208, 82586, and more. $350 firm. Fred Moran, 2604 West 24th St., Wichita, KS 67204, (316) 838-5234.

FOR SALE: BYTE: All issues from September 1975 through September 1982, except January 1976. Best offer over $200. George Colman, 44 Fox Hill Rd., Framingham, MA 01701, (617) 879-4031, evenings and weekends.

FOR SALE: Digital Group cards: Parallel, TV/CASS, Z80 CPU: $30 each; Serial: $40; Ham: $75; 32K Memory: $80; Proto: $20; UNROM: $15. Dual 801R drives and DD Controller: $400 or best offer. Keyboard: $40; terminated expanded motherboard: $75; printer: $40. Jerry Flanders, 1767 Gregory Lake Rd., North Augusta, SC 29841, (803) 278-0984.

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WANTED: Seeking information for a graduate research project in computer music and music education. Also interested in looking at privately developed music programs for any microcomputer system. Jerry Ozipko, 12223 Eighty-Seventh St., Edmonton, Alberta T5B 3N9, Canada, (403) 477-2984.

FOR SALE: IBM 3101 Video terminal in good condition: $200 plus shipping. Shugart 860 disk drive, DS/DD 8-inch, like new: $250 plus shipping. Matthew Boytos, 19 Canal Run W, Washington Crossing, PA 18977, (215) 493-1554.

FOR SALE: NEC 8001A microcomputer (32K RAM, M-BASIC in ROM, parallel port, serial port). CPU/keyboard unit only; great shape. $100 or best offer. Thomas Trana, POB 829, East Lansing, MI 48823.

FOR SALE: Heath 3400 microprocessor course with trainer. Theodore Turk, 17820 Schenely Ave., Cleveland, OH 44119, (216) 692-1607.

FOR SALE: Heathkit H-89, 48K RAM, 100K floppy-disk drive, monitor, two serial ports, and more. $1000 or best offer. Peter Lunde, 104 Spragg Circle, Markham, Ontario L3P 5C2, Canada, (416) 471-1616.

FOR SALE: MPX-16 microcomputer, 256K, two DS/DD Tandon drives, IBM-type Key Tronic keyboard, Quadcolor-I color graphics adapter, 640 by 200 NEC RGB monitor, Epson MX-80 printer. $1500. Narayan Nayak, 1 Foxglove Court, Yarmouth, ME 04096, (207) 846-3867.

FOR SALE: Radio Shack LP-I (Centronics 779) printer; willing to trade. Set of *ACCESS Journal*, No. 1 to No. 24. Jerry Sabin, 6022 Sage Dr., Orlando, FL 32807.

WANTED: Seattle and Tecmar S-100 boards. Must be fully operational with complete documentation and schematics. A. B. Price, 545 East Orange Grove, Burbank, CA 91501, (818) 841-8542.

FOR SALE: Atari 800XL, 64K, with disk drive, printer, and more. $525 or best offer. Duy Nguyen, 3783 Kauai Dr., San Jose, CA 95111, (408) 629-5965.

FOR SALE: Tecmar 5-megabyte removable hard-disk subsystem for IBM PC or compatibles. Includes controller, three cartridges, and all documentation. $650. Will pay shipping. Mike Heck, 1104 Continental Dr., Harleysville, PA 19438, (215) 368-7059.

WANTED: Documentation on Rockwell AIM 6500-series micros. Hardware manuals, schematics, programmer's manuals, memory map, etc. Also information on any peripherals or operating systems still available. Will pay shipping. Rick Gerlach, RD 1, Box 300, Wallkill, NY 12589.

FOR SALE: Heathkit H-89 microcomputer, two drives, serial card, Magnolia Microsystems 128K card, Novation Auto 212 1200-bps modem, and more. $700 plus shipping. Michael Smith, 3203 Alma, Palo Alto, CA 94306-2925, (415) 494-7098.

WANTED: Someone willing to trade their used Apple IIe with one disk drive for TRS-80 Model 100 (24K) with DMP-105 printer and acoustic couplers. All manuals and cables included. Daniel Warren, 10 Parkview Ave., Buffalo, NY 14210, (716) 822-7191.

FOR SALE: Apple accessories: speech synthesizer: $50; 16-channel A/D plus D/A: $150; clock/calendar: $140; RF modulator: $30. Full documentation. Excellent condition. J. Michael Callahan, Old Colony Rd., Eastford, CT 06242, (203) 974-3842.

FOR SALE: Cromemco Z80 S-100 kit. Dual 8-inch drives, CRT: $800. Factory-built dual 5¼-inch drives and 64K: $800. J. Soderblom, POB 160, Olema, CA 94950, (415) 663-8356.

FOR SALE: Used Alpha Micro Systems AM-1000 multiuser system. Dual 800K drives, 128K RAM (68000), three serial ports and multiuser operating system. Includes AM-60 terminal and more. $3000. Creigh Shank, POB 4764, Coral Gables, FL 33114, (305) 442-0234. ■

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B·O·M·B

BYTE's Ongoing Monitor Box

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BOMB *Results*

ENTER: THE WINNERS

According to Webster: "Microcomputer Color Graphics—Observations," Bruce Webster's column, wins first place in December BYTE. In second is Ciarcia's Circuit Cellar: "Turnkey Bulletin-Board System" by Steve Ciarcia. "The Norton Utilities" is third: Rubin Rabinovitz wins the $100 bonus because his Software Review was the first nonstaff-written article to appear in the lineup. In fourth place, and the winner of the $50 bonus, is Bob Troiano for his System Review of "The AT&T PC 6300." Dick Pountain's BYTE U.K. covering "The Torch Triple X" came in fifth. We all applaud the winners of the final 1985 issue.

R·E·A·D·E·R S·E·R·V·I·C·E

TO GET FURTHER information on the products advertised in BYTE, either pick up your touch-tone telephone and use TIPS (if you are a subscriber), or fill out the reader service card. Either way full instructions are provided following this reader service index which is provided as an additional service by the publisher, who assumes no liability for errors or omissions. *Correspond directly with company.

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3. ☐ ☐ ☐ [#] [#] 8. ☐ ☐ ☐ [#] [#] 12. ☐ ☐ ☐ [#] [#] 16. ☐ ☐ ☐ [#] [#]
4. ☐ ☐ ☐ [#] [#] 9. ☐ ☐ ☐ [#] [#] 13. ☐ ☐ ☐ [#] [#] 17. ☐ ☐ ☐ [#] [#]
5. ☐ ☐ ☐ [#] [#]

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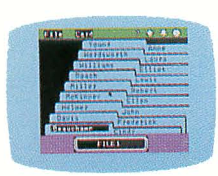
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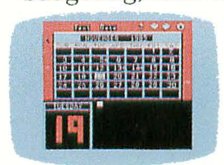
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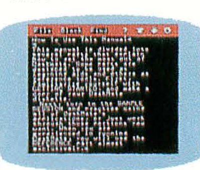
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